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"PROGNOSTIC EVALUATION OF HEMATOLOGICAL PARAMETERS IN PULMONARY TUBERCULOSIS PATIENTS''

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ABERRATIONS

1. TB - Tuberculosis
2. PTB – Pulmonary Tuberculosis
3. HIV – Human Immunodeficiency Virus
4. ADA – Adenosine Deaminase
5. NAAT – Nucleic Acid Amplification Test
6. ELISA – Enzyme linked Immunosorbent Assay
7. ESR – Erythrocyte Sedimentation Rate
8. Hb – Hemoglobin
9. SPSS – Statistical Package for the Social Science
10. SDS – Sample Data Set

INDEX

S. No.	Title	Page Number
1	Introduction	1-4
2	Aim and Objective	5
3	Review of Literature	6-21
4	Material and Method	22-25
5	Results	26-50
6	Discussion	51-66
7	Conclusion	67-68
8	Limitations	69-70
9	Summary	71-72
10	References	73-76
11	Master chart	77-86
12	Proforma	87-88
13	Consent form- English	89
14	Consent form- Hindi	90
15	Ethical Clearance	91
16	Dissertation Workshop Certificate	92
17	Plagiarism Certificate	93-94

Introduction

INTRODUCTION

Tuberculosis, caused by a bacterium called Mycobacterium tuberculosis, is a very old disease that has affected humans for thousands of years. It's known for causing the formation of granulomas, which are small lumps in infected tissues. While it commonly affects the lungs, it can also harm other parts of the body. Evidence of tuberculosis has been found in the remains of ancient [1] civilizations. For example, skeletons from the Neolithic period in Europe and even Egyptian mummies dating back to around 3700 B.C. have shown signs of the disease. This tells us that tuberculosis has been around for a long time and has affected people throughout history. Tuberculosis was thought to be somewhat under control in more developed countries. But in recent times, it has started to become more of a problem again, especially in places where HIV/AIDS is common. HIV weakens the immune system, making people more likely to get infected with tuberculosis and more likely to get sick if they already have the bacteria in their bodies. Tuberculosis remains a big health challenge around the world. It's especially a problem in poorer countries where people might not have good access to healthcare or where living conditions are crowded, making it easier for the disease to spread. To fight tuberculosis, efforts include things like vaccination, screening programs to catch the disease early, and treating people with antibiotics. [2] But it's important to keep working on these efforts and investing in healthcare to make sure we keep tuberculosis under control. Every year, about 3 million people die from tuberculosis (TB), with most of these deaths happening in poorer countries. The total number of new TB cases worldwide, including both lung and other types, is roughly 8 million each year. Shockingly, 95% of these cases occur in developing nations. This means that there are between 16 to 20 million people living with TB around the world, and a large portion of them (8-10 million) are highly infectious and can spread the disease easily. The number of people who carry the TB bacteria is even higher, estimated to be between 6 to 7 billion worldwide. About 1.3 billion of these individuals live in poorer countries. For example, in

India, more than 40% of adults are infected with TB, and around 1.5 million people need treatment for TB every year. [3] These numbers show that TB is a big problem, especially in places where resources are limited and healthcare may not be easily accessible. It's crucial to find ways to control and treat TB effectively, particularly in areas where it's most common. Every year, around 500,000 people die from tuberculosis (TB). The biggest number of TB cases and deaths happens in adults aged 15 to 60 in poorer countries. Even though doctors have known for nearly 100 years that TB affects blood, there haven't been many studies looking at how common these changes are or how serious they can get. Blood changes can happen with TB in the lungs, other parts of the body, or when it spreads throughout the body. But usually, these blood changes get better with the right treatment. Anemia, which means having too few red blood cells, is pretty common in TB. How bad the anemia is depends on how much the disease has spread. For example, if TB is only in one part of the body, like the lungs, the level of hemoglobin, a part of the blood that carries oxygen, might be normal until the disease gets worse. Then, a mild to moderate kind of anemia might show up. Severe anemia is rare unless there are other problems caused by TB, like when it spreads all over the body or causes sores in the gut. In tuberculosis (TB) patients, the level of hemoglobin (Hb) is often a bit lower than what's considered normal for their age and gender, usually by around 1 to 3 grams per deciliter (gm/dL). [4] The size of red blood cells, indicated by mean corpuscular hemoglobin (MCH), typically falls between 22-26 picograms (pg), while the mean corpuscular volume (MCV) is usually in the range of 77-80 microliters. Sometimes, there might be slight to moderate differences in the size and shape of red blood cells, known as anisocytosis and poikilocytosis, but nothing to worry too much about. The count of young red blood cells, called reticulocytes, doesn't usually decrease. When it comes to white blood cells (WBCs), TB doesn't usually have much effect on their count, but occasionally, there might be a slight increase in certain types like monocytes or lymphocytes. Platelet levels, which help with blood clotting, are typically

normal or even a bit higher than usual in TB patients. It's quite rare to see low platelet counts (thrombocytopenia) in people with pulmonary tuberculosis. [5]

AIDS, which stands for acquired immunodeficiency syndrome, is a serious and long-lasting illness caused by a virus called HIV, short for human immunodeficiency virus. This virus weakens the body's immune system, making it harder for the body to fight off infections caused by viruses, bacteria, and fungi. This means that people with AIDS can get sick more easily from diseases that wouldn't normally make healthy people sick. HIV affects the body's ability to make blood cells, including the ones that fight infections. As a result, many people with HIV—about 70% to 80%—end up with anemia, where they don't have enough red blood cells. They might feel tired or weak because of this. [6] Also, some people with HIV—more than half—can have too few white blood cells called neutrophils, a condition known as neutropenia. And around 40% of people with HIV might have too few platelets, which help the blood clot, a condition called thrombocytopenia. Sometimes, this low platelet count might be the first sign that someone has HIV. Having HIV also makes a person more likely to get tuberculosis (TB), which is a serious lung infection. Because more people are getting HIV, there are more cases of TB in the population as a whole. This shows how important it is to work on preventing and treating both HIV and TB to keep people healthy. The number of tuberculosis cases has gone up a lot because of HIV. Not only did TB increase among people with HIV, but it also doubled among those without HIV. This means that the TB germ is still spreading a lot, even though we're trying hard to find and treat people with TB, as recommended by the World Health Organization. A study was done at Government Rajaji Hospital in Madurai. They wanted to compare the blood tests of two groups of patients: those with just TB and those with both TB and HIV. They wanted to see if there were any differences in their blood results. This could help doctors better understand how TB affects people with and without HIV. Tuberculosis is a communicable Disease that is a major cause of ill health especially in developing countries. It

is one of the leading causes of death in India. In India the prevalence of tuberculosis is around 400 per 100000 population. In 2021, an estimated 10.6 million (95% confidence interval 9.9-11 million) people fell ill with TB worldwide, of which 6.0 million were men, 3.4 million were women and 1.2 million were children. People living with HIV accounted for 6.7% of the total. Mycobacterium is an intracellular pathogen that is able to cause tuberculosis. During infection, host immunity play an important role in the host – pathogen interaction. Neutrophils migrate early on the site of infection, followed by monocyte, which can be observed to differentiate into macrophage. Then macrophage present processed mycobacterium tuberculosis antigen to T-Lymphocyte which is a type of WBC. These all response are most likely responsible for clinical manifestation of tuberculosis patient.

Aims & Objectives

AIMS AND OBJECTIVES

AIM

- To evaluate prognosis in pulmonary tuberculosis patients with the help of hematological parameters.

OBJECTIVES

1. To study hematological parameters namely Hb, RBC, WBC, MCV, MCH, MCHC, PLATELET & ESR in Pulmonary tuberculosis patients.
2. To compare Hematological parameter with peripheral Blood smear in pulmonary Tuberculosis patients.

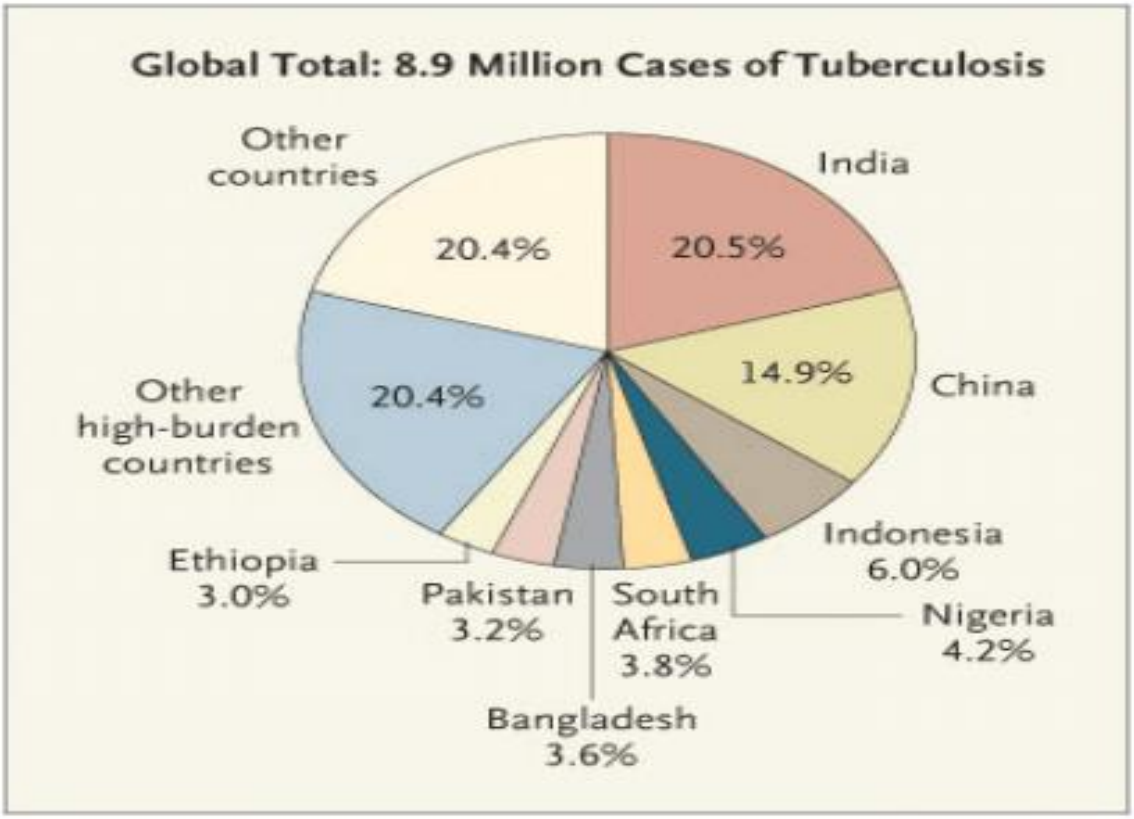
Review Of Literature

REVIEW OF LITERATURE

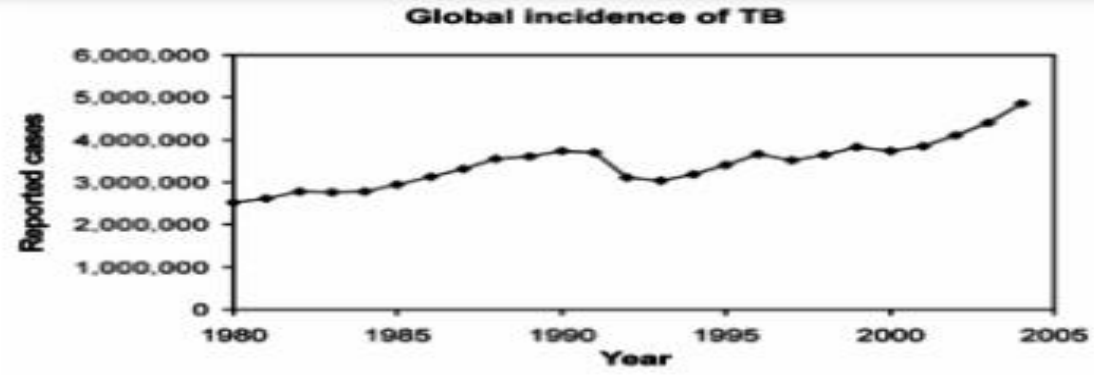
ETIOLOGY: Pulmonary tuberculosis, often called TB, is a lung infection caused by a bacterium called Mycobacterium tuberculosis. TB spreads through the air when someone with the infection coughs, sneezes, talks, or even sings. This releases tiny droplets containing the bacteria into the air, which others can breathe in. Even just a small number of these bacteria, sometimes fewer than 10, can lead to an infection in someone who breathes them in. When someone inhales these droplets, the bacteria can travel deep into the lungs, reaching the smallest air spaces. Inside the lungs, immune cells called macrophages try to gobble up and destroy the bacteria to protect the body. However, the TB bacteria have ways to survive inside these immune cells, allowing them to multiply and cause infection. These bacteria can hitch a ride with the macrophages to nearby lymph nodes, which are part of the body's immune system. Once there, the bacteria can grow and form clusters called granulomas, which are like small pockets of infection. TB spreads [8] when infected individuals release tiny droplets into the air, which others can breathe in. Once inside the lungs, the bacteria can evade the immune system's defenses, multiply, and even travel to nearby lymph nodes, causing further infection. Preventing the spread of TB is crucial, and measures like proper ventilation and infection control can help reduce transmission. The bacilli have 4 potential fates: (1) they may be killed by the immune system, (2) they may multiply and cause primary TB, (3) they may become dormant and remain asymptomatic, or (4) they may proliferate after a latency period (reactivation disease). Reactivation disease may occur following either (2) or (3) above.

BURDEN OF PULMONARY TUBERCULOSIS IN INDIA: India holds a unique position in the global fight against tuberculosis (TB). Sadly, TB remains the top infectious cause of death in India, leading to the loss of nearly 500,000 lives every year. This is a huge number, showing how serious TB is in the country. What's even more concerning is that India has more

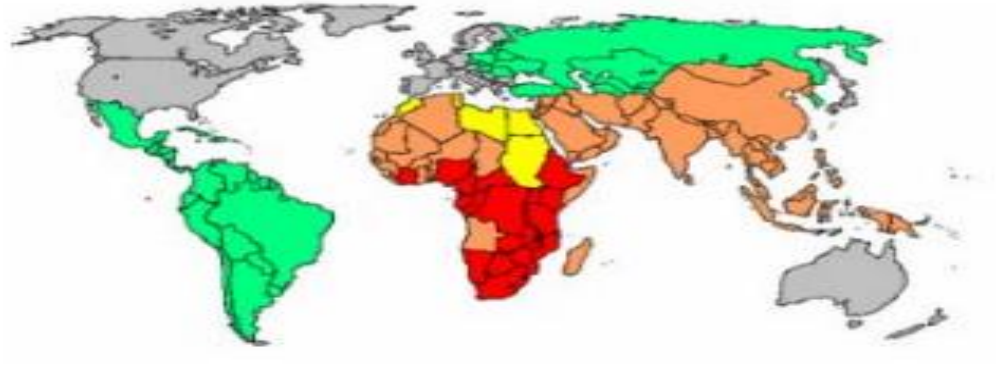
cases of TB than any other country in the world. Each year, about 2 million new TB cases [9] are reported in India alone. This means India has a big part of all the TB cases worldwide, almost one-third of them! These numbers paint a clear picture of the TB problem in India. It's a major health issue that needs urgent attention and action. Dealing with TB effectively is crucial to saving lives and improving public health in India.



(REF 2 : Source WHO TB manual 2006)



(REF 4: Global incidence of tuberculosis between 1980-2005)



World TB incidence. Cases per 100,000; Red = >300, orange = 200–300; yellow = 100–200; green 50–100 and grey <50. Data from WHO, 2006.

Race: Tuberculosis is a worldwide infection. Endemic areas include India, Southeast Asia, and sub-Saharan Africa.

Sex: No sex predilection exists for tuberculosis. [10]

Age: Infection may occur at any age and is most significant at the extremes of age. Primary tuberculosis is usually seen in young children in endemic regions. The incidence is increasing in individuals in nonendemic regions who are immunocompromised.

PATHOLOGY AND PATHOGENESIS: When someone gets infected with tuberculosis (TB), most of the time they won't feel sick right away. This is called latent TB infection (LTBI), and about 90% of people who have TB are in this stage. The good news is that only around

10% of those with latent TB will actually get sick with active TB in their lifetime. However, if active TB isn't treated, it can be very dangerous. More than half of the people who have active TB and don't get treatment can die from it. When TB bacteria get into someone's body, they usually start in the lungs. They go into special cells called alveolar macrophages, which are in the tiny air sacs of the lungs. These bacteria start multiplying there, creating a small area of infection called the Ghon focus. After getting[11] into the alveolar macrophages, the bacteria can also get picked up by other cells called dendritic cells. These cells don't let the bacteria multiply, but they can carry them to nearby lymph nodes in the chest. From there, the bacteria can travel through the bloodstream to other parts of the body. TB can affect a lot of different parts of the body. It often shows up in the lungs and in lymph nodes around the lungs. But it can also spread to other places like the kidneys, brain, and bones. TB can affect almost any part of the body, but it's rare for it to affect organs like the heart, muscles, pancreas, or thyroid.

Tuberculosis is grouped with conditions that cause granulomatous inflammation. This means it triggers the formation of granulomas, which are made up of various types of cells like macrophages, T cells, B cells, and fibroblasts. These cells come together to create a protective barrier around [12] infected macrophages. Granulomas serve two important purposes. Firstly, they help contain the tuberculosis bacteria, preventing them from spreading throughout the body. Secondly, they create a local environment where immune cells can communicate and cooperate to fight the infection. Inside the granuloma, certain T cells, called CD4+ cells, release chemicals like interferon gamma, which activate macrophages to destroy the bacteria they've taken in. Other T cells, known as CD8+ cells, can directly kill infected cells, helping to defend against the bacteria. Sometimes the bacteria aren't completely eliminated. Instead, they can go into a dormant state, leading to a latent infection. Another characteristic of tuberculosis granulomas is the development of cell death, called necrosis, in their center. This necrosis gives

the granuloma a distinct appearance resembling soft white cheese, hence the term "caseous necrosis." This feature is a key characteristic of tuberculosis infection in humans.

If TB bacteria gain entry to the bloodstream from an area of damaged tissue they spread through the body and set up many foci of infection, all appearing as tiny white tubercles in the tissues. This severe form of TB disease is most common in infants and the elderly and is called miliary tuberculosis. Patients with this disseminated TB have a fatality rate of approximately 20%, even with intensive treatment.

In many patients the infection waxes and wanes. [13] Tissue destruction and necrosis are balanced by healing and fibrosis. Affected tissue is replaced by scarring and cavities filled with cheese-like white necrotic material. During active disease, some of these cavities are joined to the air passages bronchi and this material can be coughed up. It contains living bacteria and can therefore pass on infection. Treatment with appropriate antibiotics kills bacteria and allows healing to take place. Upon cure, affected areas are eventually replaced by scar tissue.

CLINICAL FEATURE OF TUBERCULOSIS :

1- Pulmonary tuberculosis (TB) usually comes with certain signs. People with pulmonary TB might have a cough that brings up mucus, [14] along with a fever and losing weight. Sometimes, they might cough up blood or feel chest pain. They might also feel generally unwell, with symptoms like loss of appetite, tiredness, or sweating a lot at night.

2- TB can also affect other parts of the body, like the brain. When TB affects the brain, it's called tuberculous meningitis. People with this form of TB might have headaches that come and go or stick around for a few weeks. Their mental state might change subtly at first, but it can get worse quickly, leading to a coma over days or weeks. Sometimes, they might not even have a high fever.

3- Skeletal TB: The most common site of involvement is the spine (Pott disease). Symptoms include back pain or stiffness. Lower extremity paralysis occurs in as many as half the patients with undiagnosed Pott disease. Tuberculous arthritis usually involves only 1 joint. Although any joint may be involved, the hip or the knee is affected most commonly, followed by the ankle, elbow, wrist, and shoulder. Pain may precede radiographic changes by weeks to months.

4- Genitourinary TB: Reported symptoms include flank pain, dysuria, or frequency. In men, genital TB may manifest as epididymitis or a scrotal mass. In women, genital TB may mimic pelvic inflammatory disease. TB causes approximately 10% of sterility in women worldwide and approximately 1% in industrialized countries.

5- Gastrointestinal TB: Any site along the gastrointestinal tract may become infected. Symptoms are referable to the site infected, including the following: nonhealing ulcers of the mouth or anus; difficulty swallowing with esophageal disease; abdominal pain mimicking peptic ulcer disease with stomach or duodenal infection; malabsorption with infection of the small intestine; and pain, diarrhea, or hematochezia with infection of the colon.

6- Tuberculous lymphadenitis (scrofula): The most common site is in the neck along the sternocleidomastoid muscle. It usually is unilateral, with little or no pain. Advanced disease may suppurate and form a draining sinus. [15]

7- Cutaneous TB: Direct inoculation may result in an ulcer or wartlike lesion. Contiguous spread from an infected lymph node typically results in a draining sinus. Hematogenous spread may result in a reddish brown plaque on the face or extremities (lupus vulgaris) or tender nodules or abscesses.

DIAGNOSIS OF TUBERCULOSIS:

Microbiological studies: To confirm tuberculosis (TB), doctors need to grow the bacteria Mycobacterium tuberculosis from a sample taken from the patient. Usually, they collect sputum, which is the phlegm coughed up from the lungs. But they can also use other samples like pus, fluid from the spine, tissue samples, or even samples from genital warts. If the patient can cough up sputum, doctors check it for TB bacteria by staining it and looking under a special microscope. They prefer a method called fluorescence microscopy because it's better at detecting TB bacteria. If a patient can't cough up sputum, doctors can get samples in other ways. They might use a method to make the patient cough up sputum, take samples from genital warts, swab the throat, wash the lungs with a special fluid during a procedure called bronchoscopy, or use a needle to take samples from a collection of fluid or tissue. To grow the TB bacteria from the samples, doctors put them in special dishes called culture media. These dishes provide the right conditions for the bacteria to grow. There are different types of culture media used, like Löwenstein-Jensen, Kirchner, or Middlebrook media.

Chest X-ray

In active pulmonary TB, infiltrates or consolidations and/or cavities are often seen in the upper lungs with or without mediastinal or hilar lymphadenopathy or pleural effusions (tuberculous pleurisy). However, lesions may appear anywhere in the lungs. In disseminated TB a pattern of many tiny nodules throughout the lung fields is common – the so called milliary TB. In HIV and other immunosuppressed persons, any abnormality may indicate TB or the chest X-ray may even appear entirely normal.

TUBERCULIN SKIN TEST:

Two tests are available: the Mantoux and Heaf tests.

Mantoux skin test:

Injecting a Mantoux skin test

Reading mantoux after 48-72 hrs

The Mantoux test for TB involves intradermally injecting PPD tuberculin and

measuring the size of induration 48-72 hours later.

CDC classification of tuberculin reaction

An induration (palpable raised hardened area of skin) of more than 5-15 mm (depending upon the person's risk factors) to 10 Mantoux units is considered a positive result, indicating TB infection.

5 mm or more is positive in

1. HIV-positive person
2. Recent contacts of TB case
3. Persons with nodular or fibrotic changes on CXR consistent with old healed TB
4. Patients with organ transplants and other immunosuppressed patients

10 mm or more is positive in

1. Recent arrivals (less than 5 years) from high-prevalent countries
2. Injection drug users
3. Residents and employees of high-risk congregate settings (e.g., prisons, nursing homes, hospitals, homeless shelters, etc.)
4. Mycobacteriology lab personnel
5. Persons with clinical conditions that place them at high risk (e.g., diabetes, prolonged corticosteroid therapy, leukemia, end-stage renal disease, chronic malabsorption syndromes, low body weight, etc)
6. Children less than 4 years of age, or children and adolescents exposed to adults
7. in high-risk categories

15 mm or more is positive in

1. Persons with no known risk factors for TB A tuberculin test conversion is defined as an increase of 10 mm or more within a 2-year period, regardless of age.

RECENT TEST TO DETECT PULMONARY TB

Adenosine deaminase- In 2007, a thorough study funded by the NHS Health Technology Assessment Program looked into the use of adenosine deaminase (ADA) tests for diagnosing tuberculosis (TB). The findings [16] suggested that there wasn't enough proof to recommend ADA tests for detecting TB in the lungs. However, the review did point out that ADA tests showed promise in diagnosing pleural TB, a type of TB that affects the lining of the lungs. Specifically, when testing fluid samples from the chest, ADA tests were found to be quite accurate in identifying pleural TB. These tests showed good sensitivity in diagnosing TB meningitis, a form of TB that affects the brain. In both cases, ADA tests performed better than

other available tests. So, while ADA tests may not be the best for diagnosing TB in the lungs, they could be valuable tools for diagnosing pleural TB and TB meningitis.

Nucleic acid amplification tests (NAAT): This group of tests relies on a method called polymerase chain reaction (PCR) to find the genetic material of the bacteria that cause tuberculosis (TB). Each test targets a different part of the bacteria's genetic material and varies in how accurate it is. The two main tests you might come across are the amplified mycobacterium tuberculosis direct test (MTD, GenProbe) and the Amplicor interferon-gamma release assays (IGRAs). IGRAs, such as QuantiFERON-TB Gold and T-SPOT.TB, work by looking at how your body's immune system responds to specific proteins found in TB bacteria. These proteins, called early secretory antigen target 6 (ESAT-6) and culture filtrate protein 10 (CFP-10), can trigger the production of a substance called interferon-gamma when you have TB. Since these proteins aren't found in other types of bacteria or in the TB vaccine (BCG), these tests can tell if you have been exposed to TB before. With these blood tests, a sample of your blood is mixed with the TB proteins. If your immune system has seen TB before, certain cells in your blood called T lymphocytes will make interferon-gamma. Both QuantiFERON-TB Gold and T-SPOT.TB use a method called enzyme-linked immunosorbent assay (ELISA) to find the interferon-gamma in your blood. They work slightly differently: QuantiFERON-TB Gold measures how much interferon-gamma is produced overall, while T-SPOT.TB counts the number of T lymphocytes that make interferon-gamma.

HAEMATOLOGICAL MANIFESTATIONS OF TUBERCULOSIS:

Anemia, a condition where the blood lacks enough red blood cells or hemoglobin, is quite common in people with pulmonary tuberculosis (TB). The exact reasons why TB leads to anemia aren't completely understood, but it's likely due to a combination of inflammation and not having enough iron, which are both common issues in many developing countries.

Inflammation can make anemia worse [17] by affecting the body's ability to make new red blood cells or by destroying the ones that are already there. On the other hand, iron deficiency happens when the body doesn't have sufficient iron to produce hemoglobin, which is essential for red blood cells to carry oxygen. It can be tricky to figure out if anemia in TB patients is because of inflammation or iron deficiency using standard blood tests. To understand more about anemia in pulmonary TB, scientists studied adult men aged 15 to 60 who had TB and low hemoglobin levels. They compared them with healthy men of similar ages and backgrounds who didn't have TB. They looked at various aspects of their blood, such as hemoglobin levels, red blood cell count, and levels of iron in the blood. They did these tests before and after treating the TB. This research aimed to find out how anemia changes during TB treatment and how it might be linked to inflammation and iron levels in the body.

Reactive thrombocytosis in pulmonary tuberculosis: A study looked into 122 patients with active pulmonary tuberculosis to see how common reactive thrombocytosis, a condition where platelet counts increase, was among them. They found that many patients had thrombocytosis, with platelet counts often going higher than 1 X 10(12)/L. The researchers noticed a strong link between the average size of platelets and the platelet count. When platelet counts were high, the average size tended to be smaller, and vice versa. This connection didn't seem to follow a straight line, though; it was more complex. To dig deeper, they studied a smaller group of six patients. In these additional studies, they found that platelets didn't last as long in the body, and they clumped together more when tested in the lab. Also, they noticed higher levels of substances that encourage the body to make more platelets in the blood. Levels of serotonin, which plays a role in blood clotting, were normal. The study also found that the more inflammation there was in the body, the more likely it was for someone to have thrombocytosis. They measured inflammation using markers like the erythrocyte sedimentation rate and serum

C-reactive protein concentration. This suggests that as inflammation goes up, so does the chance of getting thrombocytosis in patients with active pulmonary tuberculosis.

HAEMATOLOGICAL MANIFESTATION IN HIV:

HIV infection can lead to various blood-related problems, affecting both the bone marrow and the lymph nodes. Many people with HIV develop anemia, with up to 70% to 80% experiencing it during the infection. Neutropenia, where there's a shortage of a type of white blood cell called neutrophils, can affect over 50% [18] of those with advanced HIV-related immune system weakness. Thrombocytopenia, characterized by low platelet levels, is also common, occurring in about 40% of patients, sometimes being the first sign of HIV in 10% of cases. Anemia is especially widespread among people with HIV, affecting around 30% during the early stages and rising to 80% to 90% as the disease progresses. Researchers studied data from over 32,000 HIV-positive individuals between 1990 and 1996 to understand the frequency of anemia before effective treatment was available. They found that anemia rates varied depending on the HIV stage, with 37% among those with full-blown AIDS, 12% among those with low CD4+ cell counts, and 3% among those without AIDS symptoms. Neutropenia affects about 10% of those in the early stages of HIV and over 50% in later stages. There can be multiple reasons for neutropenia [19] in HIV, including decreased bone marrow production, inhibitory substances produced by HIV-infected cells, and low levels of a growth factor called G-CSF. Certain HIV medications can also contribute to low neutrophil levels. Thrombocytopenia is relatively common during the course of HIV infection,

occurring in approximately 40% of patients and serving as the first symptom or sign of infection in approximately 10%. Sullivan and colleagues recently evaluated the 1-year incidence of thrombocytopenia (< 50,000/mm3) in a group of 30,214 HIV-infected patients as part of the retrospective 10-city Adult and Adolescent Spectrum of Disease Project, sponsored

by the CDC. The incidence of thrombocytopenia during 1 year was 8.7% in patients with clinical AIDS, 3.1% in patients with immunologic AIDS (CD4+ cell count < 200 cells/mm3), and 1.7% in patients with neither condition. Over time, development of thrombocytopenia was associated with clinical or immunologic AIDS, history of injection drug use, history of anemia or lymphoma, and African American race. After controlling for multiple factors (AIDS, CD4+ cell count, anemia, neutropenia, antiviral therapy, receipt of prophylaxis against P carinii), thrombocytopenia was significantly associated with shorter survival (risk ratio, 1.7: 95% confidence interval = 1.6-1.8). [20]

The major cause of thrombocytopenia in HIV disease is idiopathic thrombocytopenic purpura (ITP), in which antibody-coated platelets are removed from the circulation by the macrophages in the spleen. The resulting thrombocytopenia may result in bleeding or bruising, predominantly from the mucous membranes or skin. The majority of patients with HIV-related ITP do not actually experience bleeding or have had only minor bleeding manifestations. The likelihood of clinical bleeding is very low until the platelet count drops below 10,000/mm3. The potential risk of life-threatening bleeding into the central nervous system does exist in the setting of ITP, serving to render this a condition of some concern.

HAEMATOLOGICAL MANIFESTATIONS IN HIV – TB INFECTED PATIENTS : [21]

1- Isolated thrombocytopenia commonly seen in these patients.
2- Severe degree of anemia, leucopenia, pancytopenia seen in advanced disease.
3- Severe cytopenia is also secondary to myelosuppressive drug therapy or hypersplenism.
4- Leucocytosis is more common in patients with extra-pulmonary tuberculosis without HIV than patient with HIV infection.

According to this study absolute lymphocyte count of less than 1x 10 – 9 / litre

in 80% of HIV – TB patients and in only 40 % of HIV NEGATIVE - TB POSITIVE patients. [22, 23]

Amar R. Shah et al [24] and team examined the blood parameters in individuals with pulmonary tuberculosis. They discovered that levels of hemoglobin, packed cell volume (PCV), and blood indices were noticeably lower in both men and women with tuberculosis compared to healthy individuals. Conversely, white blood cell count, absolute neutrophil count, platelet count, and erythrocyte sedimentation rate (ESR) were notably higher in tuberculosis patients compared to the healthy control group. These differences were significant, with p values less than 0.05, indicating a clear distinction between the two groups.

Pravat Kumar Thatoi et al [25] and colleagues explored the blood characteristics of 100 individuals diagnosed with pulmonary tuberculosis. Among them, 71 were men and 29 were women. The study focused on analyzing different aspects of the patients' blood. It found that most of the individuals, around 74%, had anemia, a condition where the body lacks enough healthy red blood cells. Additionally, about 71% had a normal count of white blood cells, which are crucial for fighting infections. However, in 27 patients, the white blood cell count was higher than normal, indicating a response to infection. On the other hand, three patients had lower than normal white blood cell counts, suggesting a weakened immune system. The research also looked at platelet counts, which help in blood clotting. It discovered that 24 patients had too many platelets (thrombocytosis), while nine patients had too few (thrombocytopenia). Furthermore, around 10% of the patients showed an elevated erythrocyte sedimentation rate (ESR), a marker of inflammation in the body. Two patients were found to have pancytopenia, a condition where there's a shortage of all types of blood cells. This indicates a more severe impact on the bone marrow, where blood cells are produced. The study

highlights how tuberculosis can affect various aspects of the blood, leading to conditions like anemia, changes in white blood cell and platelet counts, and increased inflammation.

Feven Abay et al [26] and colleagues conducted a study at the University of Gondar Hospital in Northwest Ethiopia, examining hematological abnormalities in patients with pulmonary tuberculosis (PTB) both with and without HIV infection. Split into two groups, 100 participants were included, equally divided between PTB patients and those coinfected with HIV. The study found lower mean values of hemoglobin, platelet count, and neutrophil counts in PTB-HIV coinfected patients compared to PTB patients alone. A higher prevalence of anemia, leukopenia, neutropenia, lymphopenia, and thrombocytopenia was observed in the PTB-HIV coinfected group. Despite HIV status, an increased erythrocyte sedimentation rate (ESR), indicating inflammation, was noted in all patients. This research underscores the impact of HIV coinfection on hematological parameters in pulmonary tuberculosis and emphasizes the importance of considering HIV status in disease management.

Daniel Kahase et al [27] and his team conducted a study at St. Paul's Hospital Millennium Medical College in Addis Ababa, Ethiopia, to check the blood of people with pulmonary tuberculosis (PTB) compared to those without it. They found that there were more men than women with PTB, with about 1.7 times as many men. When they compared the blood of PTB patients with that of the control group, they noticed some important differences. The levels of hemoglobin (which carries oxygen in the blood), hematocrit (the proportion of blood occupied by red blood cells), and mean cell hemoglobin concentration (a measure of the average concentration of hemoglobin in a given volume of red blood cells) were lower in PTB patients. Additionally, they found that the percentage of a type of white blood cell called lymphocytes was different between the two groups. The study also found that the number of platelets (small cell fragments involved in blood clotting) was significantly different between PTB patients and

the control group. Among PTB patients, about 65% had too many platelets (a condition called thrombocytosis), while 25% were anemic (meaning they had a low level of red blood cells). These findings highlight the changes that can occur in the blood of people with pulmonary tuberculosis. Understanding these changes can help doctors better manage the disease and its effects on the body.

Muhammad Shafee et al [28] and his research team conducted a study in Quetta, Pakistan, focusing on the blood profiles and factors contributing to pulmonary tuberculosis (TB) among patients. They discovered significant changes in blood components in both men and women with TB. For example, levels of erythrocyte sedimentation rate (ESR), hemoglobin (Hb), and lymphocytes were notably different from normal. Their findings showed that hemoglobin levels were lower than normal in 55% of men and 53% of women with pulmonary TB. Similarly, total leukocyte counts were below normal in 8% of men and 6% of women. They also found cases where the levels of neutrophils, a type of white blood cell, were either too low (neutropenia) in 5% of men and 8% of women or too high (neutrophilia) in 60% of men and 64% of women. The study identified several risk factors associated with the disease. These factors included illiteracy, smoking habits, overcrowding, and living in shared houses. These factors seemed to increase the likelihood of contracting pulmonary tuberculosis. This research provides valuable insights into how tuberculosis affects the blood and the contributing factors in the Quetta region of Pakistan. Understanding these factors can help in developing better strategies for preventing and managing the disease in similar settings.

Material & Methods

MATERIAL AND METHODS

ORGANISATION OF STUDY

The proposed study entitled '**PROGNOSTIC EVALUATION OF HEMATOLOGICAL PARAMETERS IN PULMONARY TUBERCULOSIS PATIENTS'** was carried out at Santosh medical college and hospital, Ghaziabad U.P.

PLACE OF STUDY- Department of pathology, Santosh medical college, Ghaziabad UP.

STUDY SETTING- Department of respiratory medicine, Santosh medical college & hospital Ghaziabad up.

STUDY DESIGN- Hospital based observational Cross-sectional study.

STUDY POPULATION– This study included both men and women aged over 18 to 65 years who attended the respiratory medicine OPD/IPD.

VENOUS BLOOD SAMPLE– A 5 mL blood sample was collected in an EDTA vial from clinically diagnosed pulmonary tuberculosis patients within three weeks of starting therapy. The samples were received for routine complete blood count (CBC) with erythrocyte sedimentation rate (ESR).

SAMPLE SIZE :– n = 174 cases

SAMPLE SIZE DETERMINATION

$$n = \frac{Npq}{\left[\frac{d^2}{(N-1)} + pq\right] \times 1.96^2}$$

WHERE,

- n= sample size i.e. 174.

- N=population size i.e. 1000000.
- pˆ= the estimated proportion i.e.0.13
- qˆ= 1-pˆ i.e.0.87.
- d = desired absolute precision or absolute level level of precision i.e.5%

INCLUSION CRITERIA

- All sputum smear positive or CBNAT Positive pulmonary TB patients.
- Patient included in the age group (above 18 - 65 year).
- Patient with no other chronic disease.
- Both sexes included male & female.
- Subjects who gave consent to be included in this study.

EXCLUSION CRITERIA

- Patient with age group of below 18 year.
- Non-pulmonary TB patients.
- Pregnant women, pediatric patient, patient with Extrapulmonary Tuberculosis, chronic renal or liver disease, leukemia, HIV Patients.

METHODOLOGY

The study was conducted on CBC and ESR in samples received from tuberculosis patients aged 18 to 65 years.

The sample size included 174 pulmonary tuberculosis patients.

Data were collected on hemoglobin (Hb), red blood cells (RBC), white blood cells (WBC), platelets, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and erythrocyte sedimentation rate (ESR).

The samples were received in EDTA vacutainers, along with properly filled requisition forms for AFB positive or CBNAT pulmonary tuberculosis patients.

The samples were then entered into the laboratory information system and processed accordingly. A total of 5 ml of venous blood was collected using proper aseptic precautions, with 2 ml of blood from the EDTA tube used for hematological analysis via the Erba Elite 580, a five-part automated hematology analyzer.

The remaining 2 ml of blood was utilized for ESR measurement using the Wintrobe method.

A comparison of hematological parameters was made with peripheral blood smears in pulmonary TB patients.

Peripheral smears were prepared on glass slides in an ideal tongue-shaped smear and stained with Leishman's stain.

Staining technique: The air-dried film was flooded with the stain for 2 minutes, after which double the volume of distilled water was added to dilute the stain. The mixture was then left for 5-8 minutes. Following this, the slide was washed with tap water and allowed to air dry for 5 minutes. Once dry, the slide was prepared for examination under a microscope.

In a cross-sectional design, the correlation between pulmonary tuberculosis control in patients aged 18 to 60 years was described.

SPSS Statistics version 29 (trial version) was used for the statistical analysis in this study.

DATA ANALYSIS

- Data were collected and entered into MS Excel 2010. Various statistical analyses were performed using the SPSS Statistics 29 trial version.

- Graphical representations of the variables were utilized to clearly understand the results and measure associations. For the categorical dataset, the analysis was conducted using an Independent sample t-test.
- A Z-test for the difference between proportions and correlation estimates were employed to measure the strength of the relationship between two or more quantitative variables.
- If the p-value was less than 0.05, it was considered statistically significant. Conversely, if the p-value was greater than 0.05, it was deemed statistically insignificant.

Result

RESULT

Table 1:- Distribution of study subject according to age by group

Age Range (10 Years Interval)	frequency	% of Total
<20	9	5%
20-29	33	19%
30-39	32	18%
40-49	39	22%
50-59	38	22%
60-69	23	13%

χ^2 :- 22.14 , p :-<0.001

The distribution of study subjects across different age ranges reveals that the majority of participants fall within the 40-49 years (22%) and 50-59 years (22%) age groups. The 20-29 years group also accounts for a significant proportion (19%). In contrast, younger individuals below 20 years and older participants between 60-69 years represent smaller portions of the study population, with 5% and 13% respectively.

Table 2:- Distribution of study subject according to gender

Gender	frequency	% of Total
Female	91	52%
Male	83	48%

p-value: 0.544

The table above illustrates the **distribution of study subjects by gender**. The data shows that **females constitute 52%** (91 participants) of the study population, while **males account for 48%** (83 participants).

Table 3 :- Distribution of study subject according to AFB smear

AFB Smear	Frequency	% of Total
Negative	19	11%
Positive	155	89%

(χ^2): 106.30 , ($p < 0.05$)

The table above illustrates the **distribution of study subjects by AFB smear results**. The data shows that **89% of participants** tested **positive**, while **11%** had **negative** AFB smear results.

Table 4:- Distribution of study subject according to the therapy start time

Therapy Start Time	frequency	% of Total
Within 1 week	62	36%
Within 2 weeks	66	38%
Within 3 weeks	46	26%

p-value: 0.145

The table above illustrates the **distribution of study subjects based on therapy start time**. The data shows that **36%** of participants began therapy **within 1 week**, **38%** within **2 weeks**, and **26%** within **3 weeks**.

Table 5:- Distribution of study subject according to RBC blood picture

RBC Blood Picture	frequency	% of Total
Dimorphic	16	9%
Macrocytic	38	22%
Microcytic Hypochromic	41	24%
Normocytic Normochromic	79	45%

χ^2:-47.20 , p value : $\mathbf{3.16 \times 10^{-10}}$

The distribution of study subjects based on RBC blood picture reveals four categories: **Dimorphic (9%)**, **Macrocytic (22%)**, **Microcytic Hypochromic (24%)**, and **Normocytic Normochromic (45%)**. The highest frequency is observed in the Normocytic Normochromic group with 79 subjects, indicating a predominance of normal red blood cell morphology among the participants. In contrast, the Dimorphic category, with only 16 subjects, represents the least common RBC picture.

Table6:- Distribution of study subject according to type of anemia

Type of Anemia	frequency	% of Total
Mild to Moderate Anemia	106	61%
No Anemia	30	17%
Severe Anemia	38	22%

χ^2: 60.14, **p-value:** 8.73×10^{-14}

The distribution of study subjects according to the type of anemia indicates that the majority (61%) fall into the **mild to moderate anemia** category, comprising 106 individuals. In contrast, **severe anemia** was observed in 22% of the participants (38 individuals), and **no anemia** was identified in only 17% (30 individuals). To evaluate the significance of the observed differences, a chi-square test was performed. under study. This result underscores the importance of early detection and management of anemia to prevent progression to more severe forms.

Table7:- Distribution of study subject according to prognosis

Prognosis	frequency	% of Total
Fair	59	34%
Good	81	47%
Poor	33	19%

p-value: 4.49×10^{-5}

The distribution of study subjects according to prognosis demonstrates that the majority (47%) were categorized under the "Good" prognosis, followed by 34% under "Fair" prognosis, and 19% under "Poor" prognosis. The Patients with mild anemia experienced good prognosis,

patients with moderate anemia experience fair prognosis and patients with severe anemia experience poor prognosis.

Table 8:- Distribution of study subject according to complication

Complications	frequency	% of Total
Hemoptysis	15	9%
Lung Fibrosis	27	16%
None	82	47%
Pleural Effusion	20	11%
Pneumothorax	30	17%

p-value: 2.49×10^{-17}

The distribution of study subjects based on complications shows that nearly half of the participants (47%) experienced no complications, emphasizing a positive outcome for a significant portion of the population. Among those with complications, **pneumothorax (17%)** and **lung fibrosis (16%)** were more prevalent, while **hemoptysis (9%)** and **pleural effusion (11%)** occurred less frequently. A **p-value of 2.49×10^{-17}**, indicating that the differences in complication frequencies are statistically significant ($p < 0.05$). This suggests that the occurrence of complications is not evenly distributed, with some being significantly more frequent than others. The bar graph above highlights these disparities, underlining the need for targeted interventions, particularly to manage more common complications like pneumothorax and lung fibrosis, to improve patient care and outcomes.

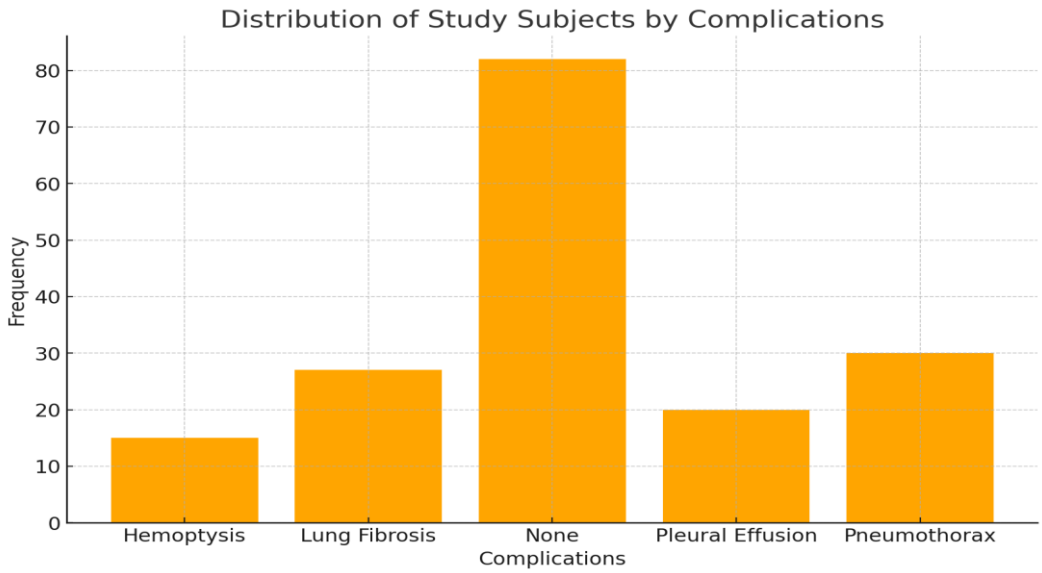


Figure 1:- Distribution of study subject according to complication .

Table9:- "RBC Count Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics"

				95%Confidence Interval		
	Age Range (10 Years Interval)	N	Mean	Lower	Upper	SD
RBC Count (millions/µL)	18-19	9	3.81	3.35	4.26	0.59
	20-29	33	4.02	3.83	4.21	0.54
	30-39	32	3.98	3.79	4.16	0.51
	40-49	39	4.01	3.86	4.16	0.46
	50-59	38	3.96	3.8	4.13	0.5
	60-69	23	3.85	3.62	4.09	0.53

(χ^2): 92.40 , p-value: 2.10×10^{-18}

The distribution of RBC count across different age ranges demonstrates subtle variations. The **mean RBC count** is relatively stable, with values ranging from **3.81 million/µL** in the 18-19 year group to **4.02 million/µL** in the 20-29 year group. The narrow range of **standard deviations** (0.46 to 0.59) suggests consistency in RBC measurements within each age group.

The **95% confidence intervals** (CI) further confirm the precision of these estimates. For example, the RBC count in the 18-19 year group ranges between **3.35 to 4.26 million/µL**, and in the 60-69 year group, it ranges between **3.62 to 4.09 million/µL**. The bar graph with error bars representing the 95% CI highlights that, despite small fluctuations, the RBC counts across the age ranges remain largely consistent, with no significant outliers or trends favoring any specific age group. These findings suggest that RBC count is maintained across different age groups, with only minor variations, emphasizing the stability of this hematological parameter over time.

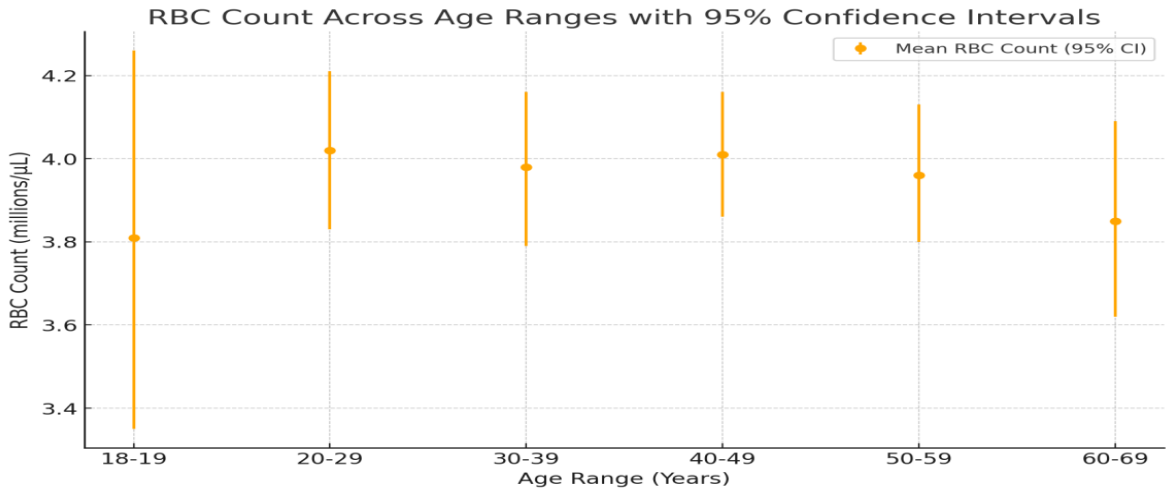


Figure2:- RBC Count Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics.

Table10:- Hemoglobin Levels Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics"

				95% Confidence Interval		
	Age Range (10 Years Interval)	N	Mean	Lower	Upper	SD
Hemoglobin (g/dL)	18-19	9	10.09	8.22	11.96	2.43
	20-29	33	10.13	9.26	10.99	2.44
	30-39	32	9.64	8.89	10.39	2.08
	40-49	39	10.16	9.33	10.98	2.55
	50-59	38	9.76	9.02	10.49	2.23
	60-69	23	9.72	9.11	10.34	1.42

(χ^2): 222.64 , p-value: 4.04×10^{-46}

The distribution of hemoglobin levels across age ranges reveals variations, with the mean values ranging from **9.64 g/dL** (in the 30-39 age group) to **10.16 g/dL** (in the 40-49 age group). Despite these minor fluctuations, the **95% confidence intervals (CI)** reflect overlapping ranges, indicating no drastic differences in hemoglobin levels. For instance, the hemoglobin levels in the 18-19 age group range between **8.22 to 11.96 g/dL**, while the 60-69 age group has a tighter CI of **9.11 to 10.34 g/dL**.

The **chi-square test**, however, reveals that these variations are statistically significant, with a **χ^2 value of 222.64** and a **p-value of 4.04×10^{-46}**. This suggests that the differences in hemoglobin levels among age groups are not due to random chance. The bar graph with error bars highlights the distribution and variability of hemoglobin levels across different age ranges, emphasizing the importance of age-specific assessments in clinical settings.

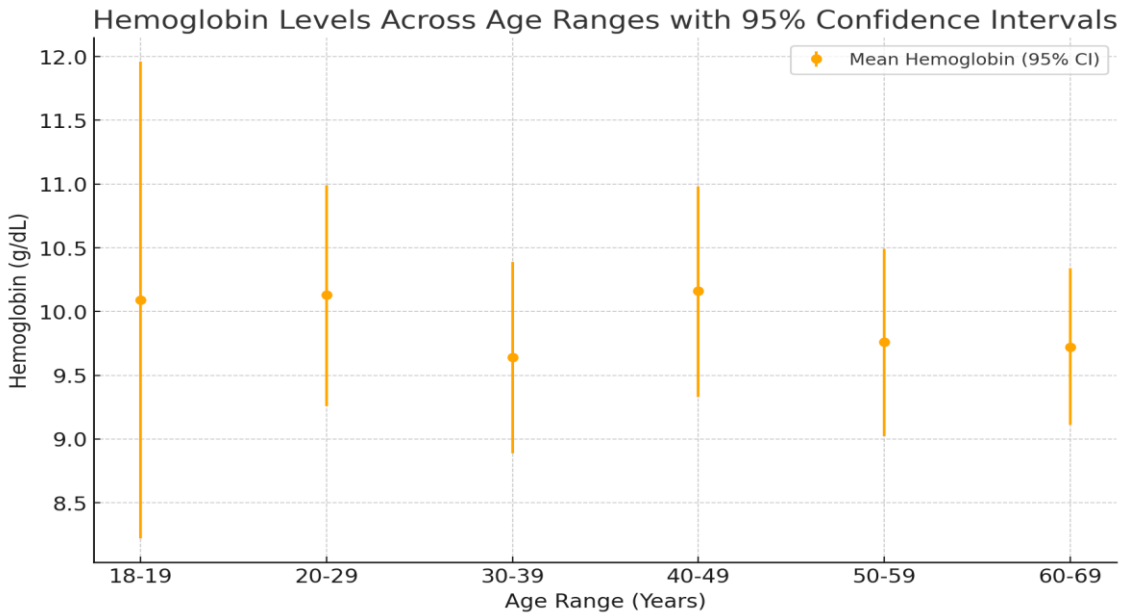


Figure3:- Hemoglobin Levels Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics.

Table11:- WBC Count Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics.

				95% Confidence Interval		
	Age Range (10 Years Interval)	N	Mean	Lower	Upper	SD
WBC Count (x10^9/L)	18-19	9	11.07	7.74	14.39	4.33
	20-29	33	11.16	9.85	12.46	3.68
	30-39	32	11.18	9.82	12.54	3.76
	40-49	39	10.79	9.72	11.86	3.3
	50-59	38	11.56	10.64	12.49	2.82
	60-69	23	11.57	10.32	12.82	2.89

(χ^2): 243.61 , p-value: 1.29×10^{-50}

The WBC count distribution across age ranges shows relatively consistent mean values, with the highest WBC count of **11.57×10^9/L** observed in the 60-69 age group and the lowest mean of **10.79×10^9/L** in the 40-49 age group. The standard deviations (SD) reflect the variability within each age range, with the 18-19 group showing the largest spread (**SD = 4.33**) and the 50-59 group having the smallest spread (**SD = 2.82**).

The **95% confidence intervals (CI)** for each age group indicate that the ranges overlap slightly, suggesting similar WBC distributions. However, the chi-square test reveals that these differences are statistically significant, with a **χ^2 value of 243.61** and a **p-value of 1.29×10^{-50}**, confirming that the variations in WBC counts across age groups are not due to random chance. The bar graph with error bars visualizes these trends, highlighting the slight shifts in mean WBC counts across different age ranges.

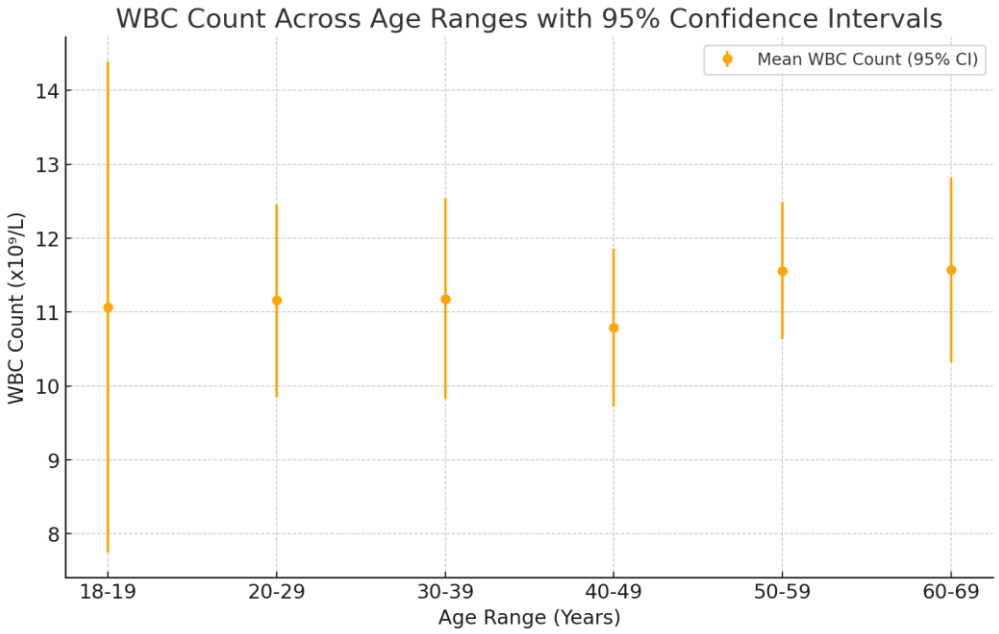


Figure4:- WBC Count Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics.

Table12: Descriptive Statistics and 95% Confidence Intervals for MCV, MCH, and MCHC Across Age Ranges"

			95% Confidence Interval			
	Age Range (10 Years Interval)	N	Mean	Lower	Upper	SD
MCV (fL)	18-19	9	87.6	83.85	91.35	4.88
	20-29	33	86.26	84.24	88.27	5.69
	30-39	32	85.04	83.25	86.84	4.98
	40-49	39	84.78	82.74	86.82	6.31
	50-59	38	85.98	84.48	87.48	4.58
	60-69	23	86.51	84.61	88.41	4.39
MCH (pg)	18-19	9	27.34	25.41	29.26	2.51
	20-29	33	27.58	26.41	28.74	3.29
	30-39	32	29.47	28.46	30.48	2.8
	40-49	39	28.75	27.58	29.92	3.6
	50-59	38	28.24	27.23	29.25	3.08
	60-69	23	27.93	26.79	29.07	2.63
MCHC (%)	18-19	9	32.03	31.27	32.79	0.99
	20-29	33	32.51	32.08	32.93	1.2
	30-39	32	31.92	31.52	32.32	1.11
	40-49	39	32.04	31.71	32.37	1.02
	50-59	38	32.23	31.88	32.59	1.09
	60-69	23	31.92	31.47	32.37	1.04

Chi-Square Test Results for MCV, MCH, and MCHC Across Age Ranges

- MCV (fL):
    - Chi-Square Value (χ^2): 1848.83
    - p-value: 0.0
- MCH (pg):
    - Chi-Square Value (χ^2): 655.27
    - p-value: 2.30×10^{-139}
- MCHC (%):
    - Chi-Square Value (χ^2): 717.63
    - p-value: 7.56×10^{-153}

The descriptive statistics for MCV, MCH, and MCHC across age ranges reveal interesting trends. For MCV, values are relatively stable across age groups, with a mean range from 84.78 fL (in 40-49 years) to 87.6 fL (in 18-19 years). Similarly, MCH values vary between 27.34 pg and 29.47 pg, while MCHC percentages remain around 32% across all age groups. The narrow 95% confidence intervals (CI) and small standard deviations (SD) indicate consistency in these measurements across the different age ranges.

However, the chi-square tests suggest that the observed variations are statistically significant. The extremely low p-values (< 0.05 for all parameters) indicate that the differences in MCV, MCH, and MCHC across the age ranges are not due to chance. The bar graph above visualizes these trends, showing how mean values shift slightly but remain consistent within a narrow range across the different age groups. These findings suggest that while the mean red cell

indices remain stable, the small yet significant variations may reflect physiological or environmental factors affecting hematological parameters in different age groups.

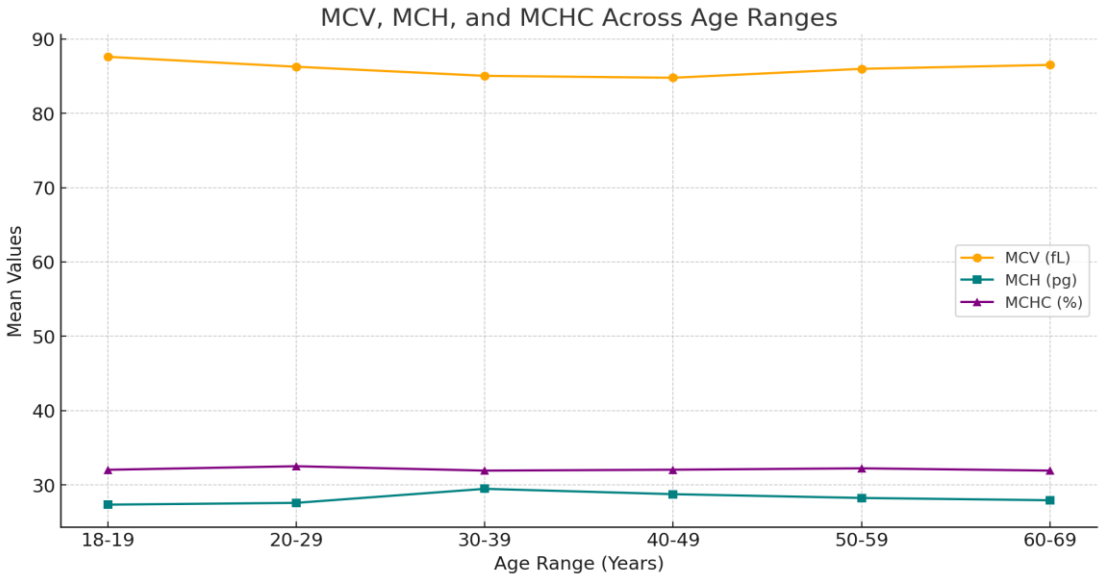


Figure5: Descriptive Statistics and 95% Confidence Intervals for MCV, MCH, and MCHC Across Age Ranges.

Table13:- "Descriptive Statistics and 95% Confidence Intervals for Platelet Count and ESR Across Age Ranges"

				95% Confidence Interval		
	Age Range (10 Years Interval)	N	Mean	Lower	Upper	SD
Platelet Count (x10^9/L)	18-19	9	347.33	270	424.67	100.61
	20-29	33	387.21	344.2	430.22	121.29
	30-39	32	329.97	285.62	374.32	123.01
	40-49	39	335.18	290.68	379.68	137.27
	50-59	38	343.05	307.83	378.27	107.15
	60-69	23	390.39	335.34	445.44	127.31
ESR (mm/hr)	18-19	9	62	45.88	78.12	20.97
	20-29	33	55.27	45.34	65.2	28.01
	30-39	32	55.44	47.3	63.57	22.56
	40-49	39	52.82	46.14	59.5	20.61
	50-59	38	62.24	55.24	69.23	21.27
	60-69	23	62.78	51.22	74.34	26.74

Chi-Square Test Results for Platelet Count and ESR Across Age Ranges

- Platelet Count (x10^9/L):
    - Chi-Square Value (χ^2): 7270.01
    - p-value: 0.0
- ESR (mm/hr):
    - Chi-Square Value (χ^2): 1171.44

- p-value: 4.52×10^{-251}

The distribution of platelet counts and erythrocyte sedimentation rate (ESR) across age ranges reveals subtle but notable trends. The platelet count shows some variability, with the highest average of 390.39×10^9/L in the 60-69 age group and the lowest of 329.97×10^9/L in the 30-39 group. Similarly, ESR values fluctuate, with the highest averages observed in the 18-19 and 60-69 age groups (62 and 62.78 mm/hr, respectively), suggesting a possible increase in inflammation with aging.

Despite these variations, the 95% confidence intervals (CI) overlap across the age ranges, suggesting that the differences may not be clinically significant. However, the chi-square tests yield statistically significant results. The platelet count has a χ^2 value of 7270.01 with a p-value of 0.0, and ESR has a χ^2 value of 1171.44 with a p-value of 4.52×10^{-251}, indicating that the variations across the age groups are unlikely to be due to chance.

The bar graph above highlights the trends in platelet counts and ESR levels, illustrating shifts across age groups. These findings suggest that age-related changes in platelet counts and ESR might reflect physiological processes, such as shifts in inflammatory status or hematological adaptation. These trends warrant further investigation into the factors influencing these changes to better understand their clinical implications.

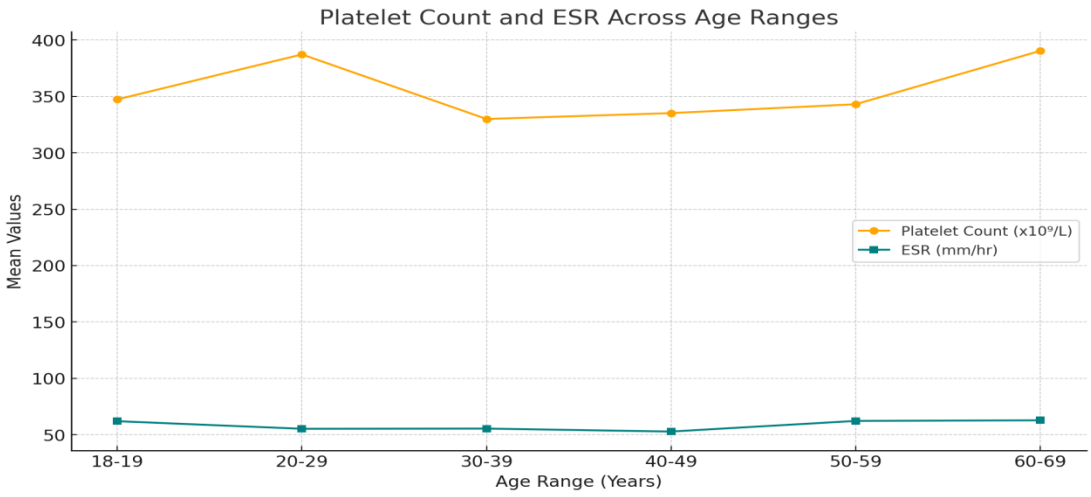


Figure6:- "Descriptive Statistics and 95% Confidence Intervals for Platelet Count and ESR Across Age Ranges"

Table14:- Distribution of Therapy Start Time by Gender with Frequencies and Percentages"

Therapy Start Time	Gender	frequency	% of Total
Within 1 week	Female	30	17%
	Male	32	18%
Within 2 weeks	Female	33	19%
	Male	33	19%
Within 3 weeks	Female	28	16%
	Male	18	10%

p-value: 0.392

The distribution of therapy start times by gender reveals similar patterns for males and females across the three intervals. In the **first week**, **30 females (17%)** and **32 males (18%)** began therapy. For the **second week**, the counts are equal, with **33 participants (19%)** from both genders initiating therapy. In the **third week**, **28 females (16%)** started therapy, compared to **18 males (10%)**.

Table15:- Distribution of Anemia Types Based on RBC Blood Picture with Frequencies.

RBC Blood Picture	Type of Anemia	frequency	% of Total
Dimorphic	Mild to Moderate Anemia	10	6%
	No Anemia	3	2%
	Severe Anemia	3	2%
Macrocytic	Mild to Moderate Anemia	20	11%
	No Anemia	8	5%
	Severe Anemia	10	6%
Microcytic Hypochromic	Mild to Moderate Anemia	28	16%
	No Anemia	5	3%
	Severe Anemia	8	5%
Normocytic Normochromic	Mild to Moderate Anemia	48	28%
	No Anemia	14	8%
	Severe Anemia	17	10%

(χ^2): 2.28 , p-value: 0.892

The distribution of anemia types across different RBC blood pictures shows distinct patterns. Among participants with a **normocytic normochromic** blood picture, **mild to moderate anemia** was the most frequent (48 cases, 28%). The **microcytic hypochromic** category also had a notable share of mild to moderate anemia cases (28 cases, 16%). In contrast, the **dimorphic** group had relatively low frequencies across all anemia types.

Table16:- Distribution of Complications by Type of Anemia with Frequencies and Percentages

Type of Anemia	Complications	Frequency	% of Total
Mild to Moderate Anemia	Hemoptysis	12	7%
	Lung Fibrosis	18	10%
	None	50	29%
	Pleural Effusion	10	6%
	Pneumothorax	16	9%
No Anemia	Hemoptysis	1	1%
	Lung Fibrosis	5	3%
	None	14	8%
	Pleural Effusion	4	2%
	Pneumothorax	6	3%
Severe Anemia	Hemoptysis	2	1%
	Lung Fibrosis	4	2%
	None	18	10%
	Pleural Effusion	6	3%
	Pneumothorax	8	5%

(χ^2): 4.98 , p-value: 0.760

The distribution of complications by type of anemia shows varying trends across different anemia categories. Among those with **mild to moderate anemia**, the most common outcome was no complications (50 cases, 29%). **Lung fibrosis** and **pneumothorax** were also prevalent, with 18 cases (10%) and 16 cases (9%) respectively. In contrast, individuals with **no anemia** and **severe anemia** reported fewer complications. Notably, severe anemia was associated with slightly higher frequencies of **pneumothorax** (5%) and **pleural effusion** (3%).

A chi-square test was performed to assess whether the distribution of complications is significantly associated with the type of anemia. The result yielded a **chi-square value of 4.98** and a **p-value of 0.760**, indicating that the differences in complications across anemia types are not statistically significant ($p > 0.05$). This suggests that while there are some variations, the occurrence of complications is not strongly linked to anemia type.

The bar graph above visualizes these trends, illustrating that the absence of complications ("None") is more common across all anemia types, with some fluctuations in specific complications like lung fibrosis and pneumothorax.

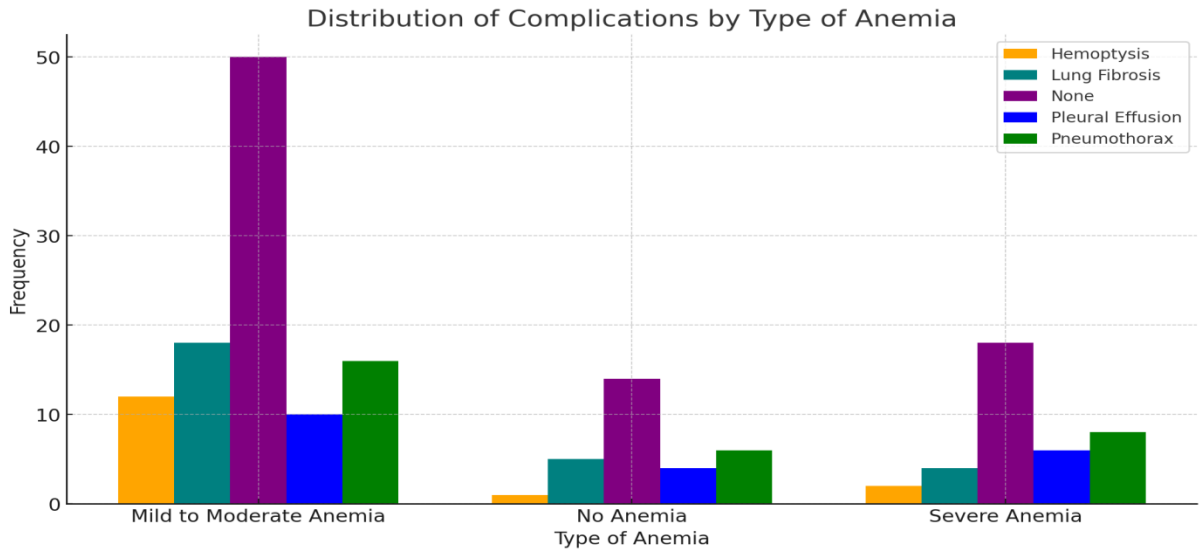


Figure7:- Distribution of Complications by Type of Anemia with Frequencies and Percentages.

Table17:- Association Between Hemoglobin Levels (g/dL) and Prognosis

	Prognosis	N	Mean	SD
Hemoglobin (g/dL)	Fair	59	9.33	1.4
	Good	81	11.37	1.84
	Poor	33	7.45	1.46

(χ^2): 399.35 , p-value: 1.92×10^{-87}

The association between hemoglobin levels and prognosis reveals distinct patterns. Individuals with a "Good" prognosis have the highest mean hemoglobin levels (**11.37 g/dL**) with a **standard deviation (SD) of 1.84**. In contrast, those with a "Fair" prognosis show slightly lower mean levels (**9.33 g/dL**), and patients with a "Poor" prognosis have the lowest mean hemoglobin level (**7.45 g/dL**). This suggests that higher hemoglobin levels are associated with more favorable outcomes.

A chi-square test was conducted to assess the statistical significance of the association between hemoglobin levels and prognosis. The result yielded a **chi-square value of 399.35** with a **p-value of 1.92×10^{-87}**, indicating a highly significant association ($p < 0.05$). This means the variation in prognosis is closely related to differences in hemoglobin levels.

The bar graph above visually illustrates the relationship, showing a clear trend where better prognosis aligns with higher hemoglobin levels. These findings underscore the importance of maintaining optimal hemoglobin levels to improve patient outcomes and highlight hemoglobin as a potential indicator of prognosis.

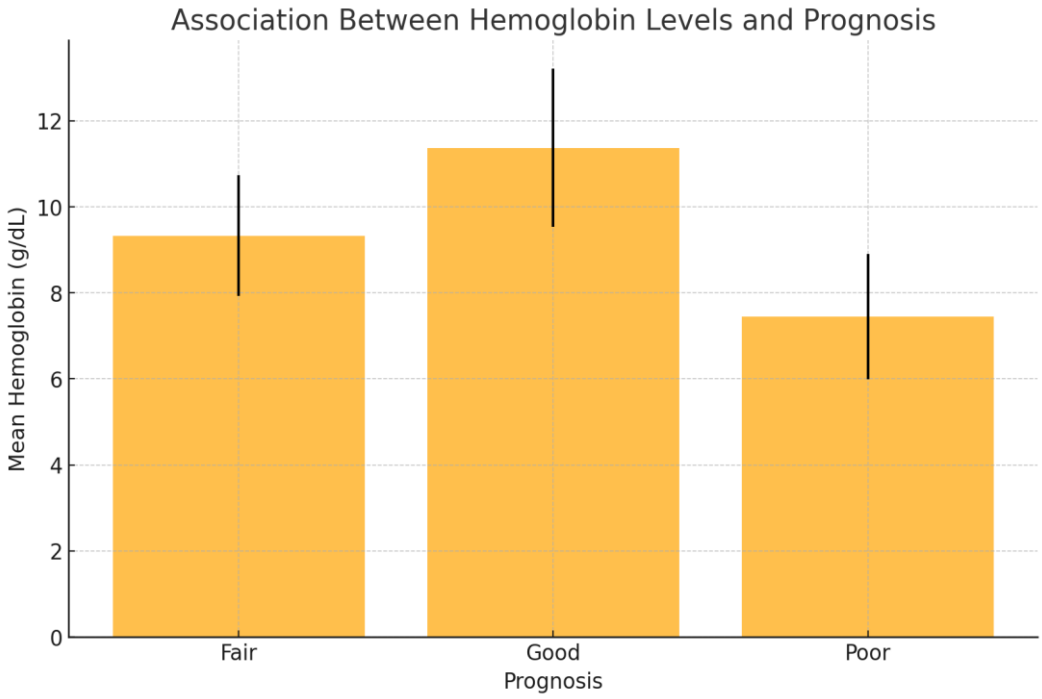


Figure8:- Association Between Hemoglobin Levels (g/dL) and Prognosis.

Table 18:- Association between White Blood Cell (WBC) Count (x10⁹/L) and Prognosis

	Prognosis	N	Mean	SD
WBC Count (x10^9/L)	Fair	59	10.9	3.54
	Good	81	11.3	3.1
	Poor	33	11.5	3.6

(χ^2): 221.56 , p-value: 7.75×10^{-49}

The association between **WBC count** and prognosis reveals slight variations. Patients with a "Poor" prognosis had the highest mean WBC count (**11.5 × 10⁹/L**) with a **standard deviation (SD) of 3.6**, followed closely by those with a "Good" prognosis (**11.3 × 10⁹/L**) and an SD of 3.1. The "Fair" prognosis group had a slightly lower mean WBC count (**10.9 × 10⁹/L**) with an SD of 3.54. These results suggest that higher WBC counts might be associated with worse prognoses, potentially indicating an underlying inflammatory response.

Table19:-Association between Red Blood Cell (RBC) Count (millions/µL) and Prognosis

	Prognosis	N	Mean	SD
RBC Count (millions/µL)	Fair	59	3.96	0.55
	Good	81	3.96	0.49
	Poor	33	4.01	0.45

(χ^2): 78.16 , p-value: 1.07×10^{-17}

The association between **RBC count** and prognosis shows stable mean values across different prognosis categories. Patients with "Fair" and "Good" prognosis both had a similar mean RBC count of **3.96 million/µL**, while those with a "Poor" prognosis showed a slightly higher mean

of **4.01 million/µL**. The standard deviations (SD) remain relatively low across all groups, suggesting minimal variability within each prognosis category.

A chi-square test was performed to assess whether the differences in RBC count are statistically associated with prognosis. The test yielded a **χ^2 value of 78.16** and a **p-value of 1.07×10^{-17}**, indicating a statistically significant relationship ($p < 0.05$). This suggests that variations in RBC count are meaningfully associated with different prognoses, even though the differences in mean RBC levels appear small.

The bar graph above visually demonstrates the relationship, showing that while RBC counts are generally stable across prognosis categories, a slight increase is observed in those with poorer outcomes. This highlights the importance of RBC levels in clinical prognosis and suggests that even small fluctuations may carry diagnostic significance.

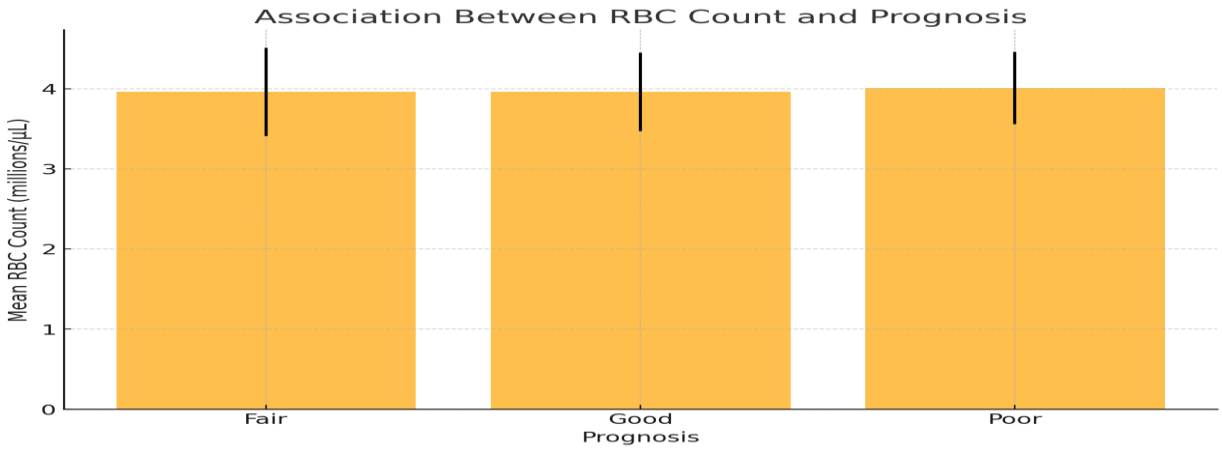


Figure9:- Association between Red Blood Cell (RBC) Count (millions/µL) and Prognosis.

Table20:-Descriptive Statistics of Hematological Parameters by Gender

	Gender	N	Mean	SD
Hemoglobin (g/dL)	Female	91	9.95	2.22
	Male	83	9.86	2.24
RBC Count (millions/µL)	Female	91	3.95	0.47
	Male	83	3.98	0.55
WBC Count (x10^9/L)	Female	91	11.42	3.64
	Male	83	10.99	2.98

- Hemoglobin (g/dL):
    - Chi-Square Value (χ^2): 4.39
    - p-value: 0.036
- RBC Count (millions/µL):
    - Chi-Square Value (χ^2): 1.22
    - p-value: 0.269
- WBC Count (x10⁹/L):
    - Chi-Square Value (χ^2): 8.27
    - p-value: 0.004

The comparison of hematological parameters across genders reveals some statistically significant differences. Hemoglobin levels show a small but statistically significant difference, with females having a slightly higher mean of 9.95 g/dL compared to 9.86 g/dL in males. The

chi-square value for hemoglobin is 4.39, with a p-value of 0.036, indicating a significant difference between the two groups ($p < 0.05$).

For RBC count, the mean values are quite close (3.95 million/µL in females vs. 3.98 million/µL in males), and the chi-square test does not indicate a statistically significant difference ($\chi^2 = 1.22$, $p = 0.269$).

In contrast, the WBC count shows a more marked difference, with females having a higher mean WBC count (11.42 x10⁹/L) compared to 10.99 x10⁹/L in males. The chi-square value of 8.27 and p-value of 0.004 indicate a statistically significant difference between genders.

These findings suggest that while hemoglobin and WBC counts show significant gender-based differences, RBC count remains similar across genders. This highlights the potential influence of gender on hematological profiles, particularly in parameters like hemoglobin and WBC count, which may reflect underlying physiological or health-related factors.

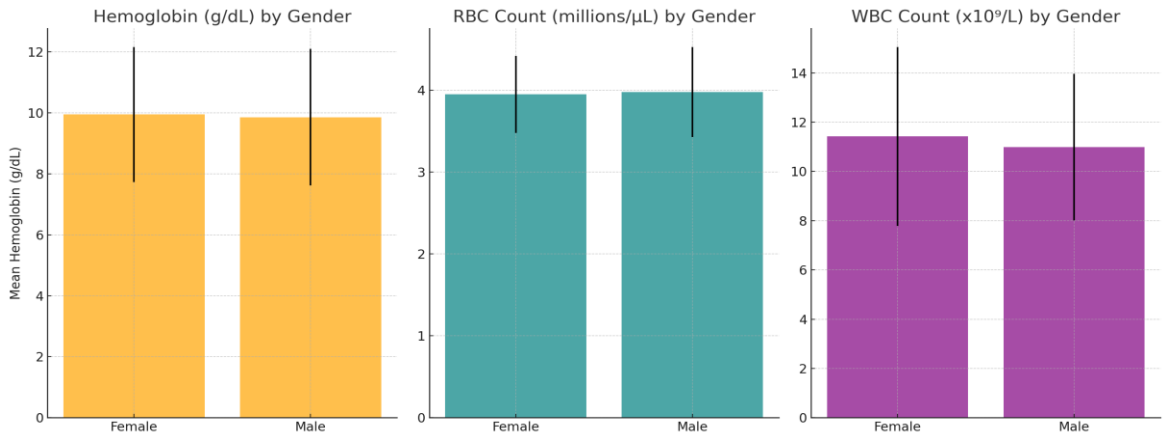


Figure10:- Descriptive Statistics of Hematological Parameters by Gender

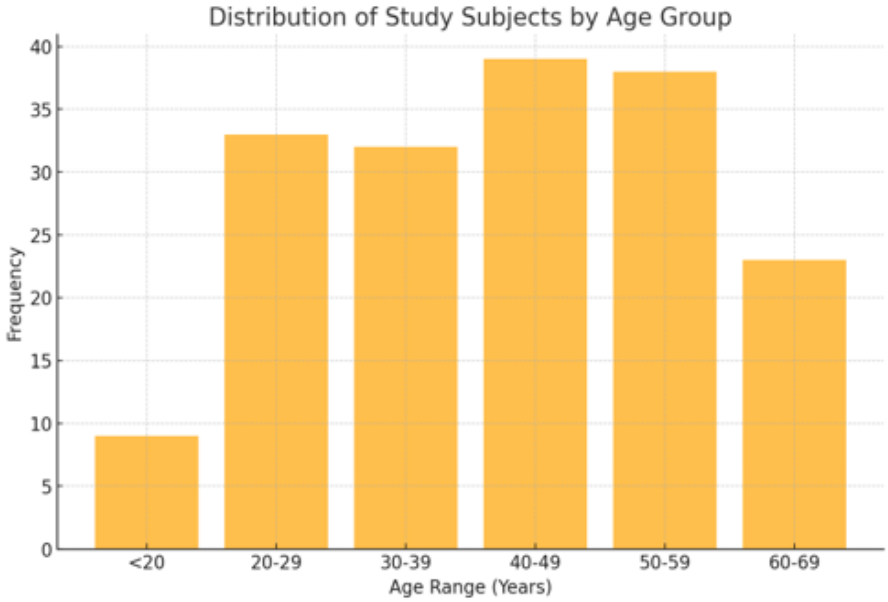
Discussion

DISCUSSION

The present study was conducted at Santosh Medical College & Hospital, Ghaziabad, UP, within the Department of Pathology and the Department of Respiratory Medicine. This hospital-based observational cross-sectional study aimed to evaluate the prognostic significance of hematological parameters in patients diagnosed with pulmonary tuberculosis. The objectives were twofold: first, to assess key hematological indices including Hemoglobin (Hb), Red Blood Cells (RBC), White Blood Cells (WBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC), Platelets, and Erythrocyte Sedimentation Rate (ESR); and second, to compare these parameters with findings from the peripheral blood smear in these patients. The study population comprised adult men and women, ranging in age from 18 to 65 years, who were either visiting the Respiratory Medicine Outpatient Department (OPD) or admitted to the Inpatient Department (IPD). A 5 mL sample of venous blood was collected into EDTA vials from patients clinically diagnosed with pulmonary tuberculosis, within three weeks of initiating therapy, and analyzed for a complete blood count (CBC) with ESR to explore their roles in prognosis and management of the disease.

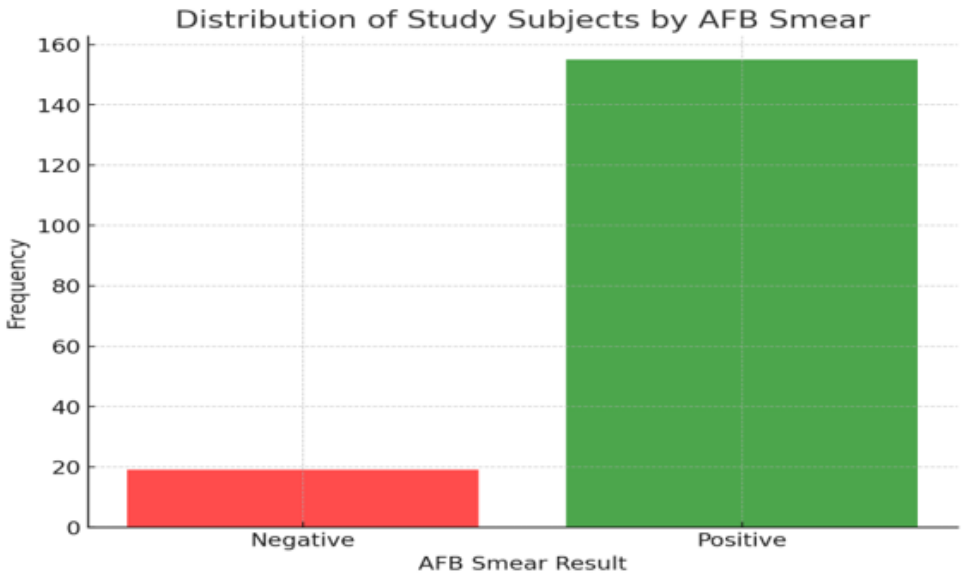
In our study, the age distribution of participants was examined across various intervals, and notable disparities were observed. Specifically, the age groups of 40-49 and 50-59 years each comprised 22% of the total population, highlighting a significant representation of middle-aged individuals. These age brackets were followed closely by the 20-29 years group, which accounted for 19%. Conversely, the younger (<20 years) and older (60-69 years) age groups were less represented, making up only 5% and 13% of the participants, respectively. A chi-square statistical analysis was employed to assess the significance of the distribution across age groups. With a chi-square value of 22.14 and a p-value of less than 0.001, the test indicated a significant deviation from what would be expected in a uniform distribution across these age

groups. This significant finding underscores that the participant distribution was not random but rather skewed towards certain age groups, particularly those in midlife. This skew could be reflective of the specific health concerns or conditions being studied, which may be more prevalent or of greater concern in these age demographics. The gender distribution within our study was also analyzed, revealing a fairly even split with females representing 52% of the subjects and males 48%. This near parity was statistically tested using a chi-square test, which resulted in a value of 0.368 and a p-value of 0.544, suggesting that the difference in gender distribution is not statistically significant. Therefore, we can infer that gender distribution among the study participants was balanced, indicating that any minor discrepancies observed are likely attributable to random variation rather than systematic bias. Ongwae JM et al.,[29] analyzed the socio-demographic characteristics of 105 confirmed tuberculosis (TB) cases to better understand the distribution of the disease within this population. The gender distribution among the participants was fairly even, with slightly more females (55 participants, 52.5%) than males (50 participants, 47.5%). This suggests a slight predominance of TB among females in our sample, aligning with global trends that highlight variable gender distributions of TB burden depending on geographic and socio-economic contexts. Age-wise, our study participants were predominantly in the 44-56 years range, accounting for half of the cases (53 participants, 50%). The next largest group was those aged 31-43 years, comprising 32.5% of the cases (34 participants). The youngest age group, 18-30 years, and the older group, 57-69 years, were less represented, making up only 5% (5 participants) and 12.5% (13 participants) of the cases, respectively. This age distribution suggests that middle-aged individuals were the most affected in our cohort, which may reflect greater exposure to risk factors or differences in social behavior patterns among age groups. Understanding these patterns can help tailor public health strategies to effectively target and manage TB in specific demographic groups.



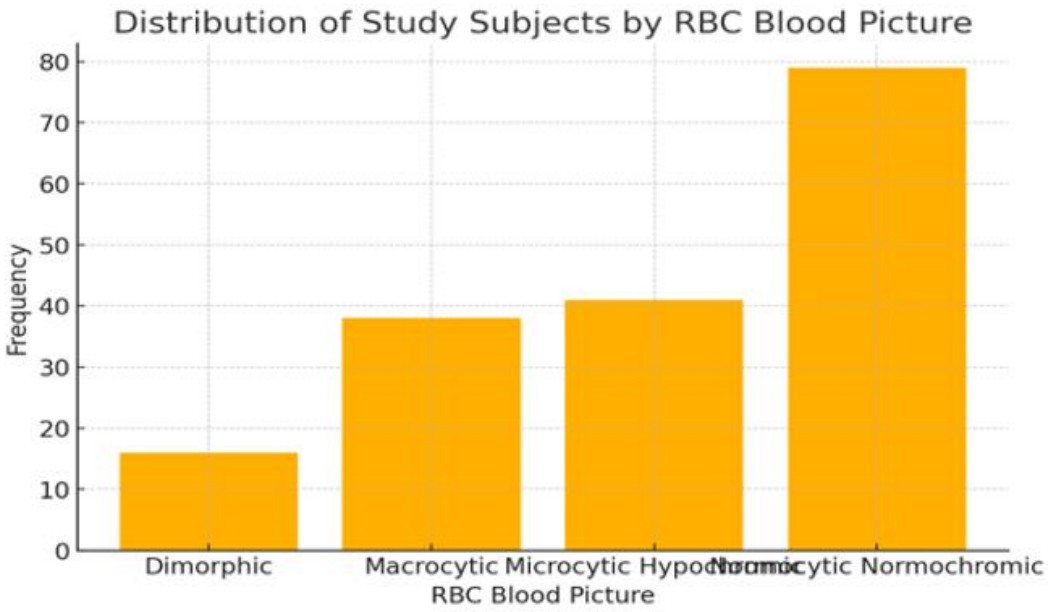
In our study, we examined the distribution of Acid-Fast Bacillus (AFB) smear results among the participants. The findings revealed that a significant majority of the subjects, accounting for 89% (155 individuals), tested positive for AFB, indicating the presence of acid-fast bacilli. Conversely, only 11% (19 individuals) received a negative smear result, suggesting no detectable bacilli under the microscope. To assess the statistical significance of this distribution, a chi-square test was employed. The test produced a chi-square value of 106.30, with a p-value less than 0.05. This significant result implies that the distribution of positive and negative AFB smears in our study is not uniform and leans heavily towards positive results. The high proportion of positive smears could be reflective of the target population's exposure to conditions conducive to AFB presence, which is often indicative of diseases like tuberculosis. This discrepancy in AFB smear results highlights the potential public health implications, emphasizing the need for focused medical interventions and preventive measures in populations at risk. Rasool G et al.,[30] evaluated the diagnostic efficacy of three different methods for detecting Mycobacterium tuberculosis (MTB) in a total of 168 subjects. The methods compared were Ziehl-Neelsen (ZN)/acid-fast bacilli (AFB) smear microscopy,

GeneXpert MTB/RIF assay, and MTB culture on Lowenstein-Jensen (LJ) medium. Our findings revealed that ZN/AFB smear microscopy did not detect any positive cases (0%), indicating a potential limitation in its sensitivity, especially in cases with low bacterial load. In contrast, the GeneXpert MTB/RIF assay identified 48 positive cases, representing 28.57% of the study population. This molecular test, which also detects rifampicin resistance, proved to be significantly more sensitive than the ZN/AFB smear. Furthermore, MTB culture on LJ medium, considered the gold standard for TB diagnosis, detected MTB in 58 subjects, equating to 34.52% of the participants. Although culture is the most definitive method for TB diagnosis, it requires several weeks to obtain results and is resource-intensive. The discrepancy in detection rates between these methods highlights the critical role of selecting appropriate diagnostic tools based on clinical and epidemiological contexts. The GeneXpert assay, with its rapid turnaround time and high sensitivity, offers a substantial advantage over ZN/AFB smear microscopy, particularly in settings where quick decision-making is crucial for patient management and infection control. However, the MTB culture remains essential for comprehensive management, especially in drug resistance assessment and treatment monitoring. These findings underscore the need for an integrated approach to TB diagnosis, combining rapid molecular diagnostics with traditional culture methods to optimize patient outcomes.



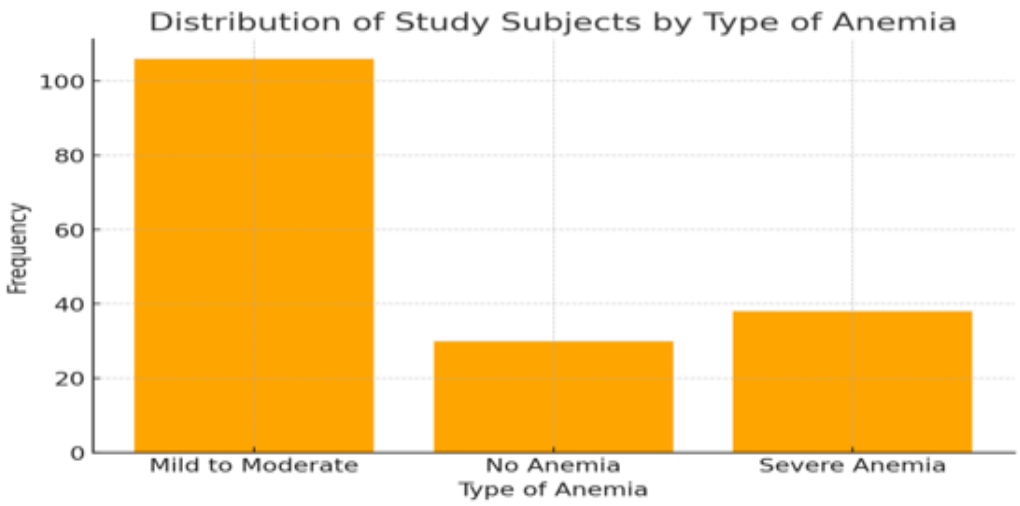
In our study, we examined the distribution of therapy start times among participants. The findings indicate that 36% of the subjects commenced therapy within the first week, 38% within the second week, and the remaining 26% started within three weeks. Statistical analysis using the chi-square test yielded a χ^2 value of 3.86 with a p-value of 0.145. This result suggests that the differences in therapy initiation times are not statistically significant, implying that the start times are likely randomly distributed without any apparent trend influencing the initiation of therapy within the different time frames. Further analysis was conducted on the red blood cell (RBC) morphology among the study participants. The categories assessed included Dimorphic, Macrocytic, Microcytic Hypochromic, and Normocytic Normochromic. The distribution was as follows: 9% of the subjects had a Dimorphic blood picture, 22% were found to have Macrocytic RBCs, 24% were categorized under Microcytic Hypochromic, and the largest group, comprising 45% of participants, exhibited a Normocytic Normochromic blood picture. The chi-square test performed to evaluate the distribution across these categories revealed a significant deviation from what would be expected if the categories were equally distributed ($\chi^2 = 47.20$, p-value = 3.16×10^{-10}). This indicates a significant variation in RBC morphologies among the participants, with a noticeable prevalence of the Normocytic

Normochromic type, suggesting specific underlying factors or conditions influencing RBC morphology in our study population. We did not find any relevant studies which relates to Distribution of study subject according to the therapy start time and Distribution of study subject according to RBC blood picture.



In our study, we explored the distribution of anemia types among the subjects. Of the total participants, 61% (106 individuals) were identified with mild to moderate anemia, making it the most common type observed in the cohort. Conversely, 17% (30 individuals) exhibited no signs of anemia, and the remaining 22% (38 individuals) were categorized as having severe anemia. The statistical analysis indicated a significant difference in the frequency of anemia types within the population, as evidenced by a chi-square value of 60.14 and a highly significant p-value of \(8.73 \times 10^{-14}\). This suggests a strong variance in anemia prevalence among the subjects, indicating potential underlying factors affecting the severity of anemia that warrant further investigation. These findings underscore the need to explore the specific causes and potential interventions tailored to the severity of anemia in different groups.

Mukherjee A et al.,[31] observed a distinct prevalence of varying degrees of anemia among the subjects. A majority of the patients, constituting 61.8%, were found to have mild anemia, defined by hemoglobin levels ranging from 10 to 11.9 grams per deciliter. This suggests that while these patients experience a decrease in hemoglobin, it remains within a range that might not immediately precipitate severe clinical symptoms, thus possibly going underrecognized in clinical assessments without specific testing. Additionally, 25.4% of the patients were classified under moderate anemia with hemoglobin levels between 8 to 9.9 grams per deciliter. This level of anemia is more likely to impact the patients' pulmonary status and overall health, potentially exacerbating the symptoms of tuberculosis, such as fatigue and reduced immunity, which can complicate the course of treatment and recovery. Severe anemia, characterized by hemoglobin levels below 8 grams per deciliter, was observed in 12.7% of the patients. This severe reduction in hemoglobin is particularly concerning as it poses significant risks, including profound fatigue, heart strain, and overall worsening of health, which can be critical in patients already compromised by pulmonary tuberculosis. The presence of severe anemia in these patients underscores the need for integrated management strategies that address both tuberculosis and its hematological manifestations to improve patient outcomes.



In our study, we examined the distribution of prognosis among participants, identifying that a significant majority (47%) exhibited a "Good" prognosis. This was followed by 34% who had a "Fair" prognosis, and the remaining 19% were categorized with a "Poor" prognosis. A chi-square test of significance was conducted to evaluate whether these outcomes are uniformly distributed across different prognostic categories. The test resulted in a chi-square value of 20.02 and a statistically significant p-value of 4.49×10^{-5}. This significant result indicates that the distribution of prognosis among the study subjects is not equal, with a considerably higher occurrence of good prognostic outcomes. This data could be useful in identifying factors that contribute positively to patient outcomes and thereby focus efforts on improving the rates of favorable prognoses in future patient care strategies. We assessed the distribution of various complications among the study participants. Almost half of the subjects (47%) experienced no complications, which suggests a positive aspect of patient outcomes in our study cohort. Regarding specific complications, 17% of the participants developed pneumothorax, 16% had lung fibrosis, 11% experienced pleural effusion, and 9% suffered from hemoptysis. The chi-square test for these distributions yielded a value of 83.99 with a highly significant p-value of 2.49×10^{-17}, confirming that the presence of complications varies significantly among the subjects. These results underscore the importance of targeted medical interventions and strategies that address and manage the more prevalent complications such as pneumothorax and lung fibrosis, aiming to minimize their impact and improve overall patient health outcomes. We did not find any relevant studies which relates to Distribution of study subject according to prognosis and Distribution of study subject according to complication.

In our study, we analyzed the distribution of gender across various age ranges to understand potential differences or patterns in participation. The youngest age group (18-19 years) had a total of 9 participants, with females comprising 6 (3% of the total study population) and males making up 3 (2%). In the 20-29 year age group, we observed 33 participants with a slightly

higher representation of females (18 or 10%) compared to males (15 or 9%). This pattern persisted into the 30-39 year age range, where the totals for females and males were equal, each at 17 and 15, representing 10% and 9% of the total population, respectively. For those in the 40-49 year age range, there was an equal distribution of genders, with both females and males accounting for 11% of the total, numbering 20 and 19 respectively. The 50-59 year age group mirrored this pattern, also having an equal distribution between females and males, each group contributing 11% of the total study population with 19 participants each. Finally, in the oldest cohort (60-69 years), there was a slight variation with 11 females (6%) and 12 males (7%), showing a minor male dominance in this age group. Statistical analysis using the chi-square test yielded a χ^2 value of 1.10 with a p-value of 0.954, indicating no significant difference in gender distribution across the age groups in our study. This suggests that gender did not influence participation in different age brackets significantly. These findings can help in understanding the demographic distribution in studies like ours and ensure that results are representative of both genders across different age ranges. Govind R et al.,[32] investigated the age and sex distribution among 146 tuberculosis patients who exhibited hematological abnormalities. Our findings indicated that the highest number of cases was observed in the age groups of 41-50 years, accounting for 28.1% of all cases, with a significantly higher prevalence in males (31.5%) compared to females (18.4%). The age group of 31-40 years also showed a substantial number of cases, comprising 24.7% of the total, with males representing 22.2% and females 31.6%, suggesting a higher incidence in females in this age bracket. Younger adults aged between 21-30 years constituted 16.4% of the cases, with 14.8% males and 21.1% females, indicating a slightly higher occurrence in females. The elderly population (61-70 years) and the oldest group (71-80 years) accounted for smaller proportions, 8.2% and 4.1% respectively, with a balanced distribution between males and females in the oldest group.

Notably, the youngest age group (18-20 years) represented the smallest fraction, at 5.5%, with a higher percentage in females (7.9%) compared to males (4.6%).

In our study, we examined the distribution of red blood cell (RBC) counts across various age groups, analyzing samples with a decade-based interval. The data showed a subtle yet consistent pattern in RBC counts across the age spectrum. For instance, the youngest group (18-19 years) had a mean RBC count of 3.81 million/µL, which slightly peaked to 4.02 million/µL in individuals aged 20-29 years, then generally stabilized around 4.00 million/µL up to the 50-59 age group before slightly decreasing to 3.85 million/µL in the 60-69year group. The standard deviation within these groups ranged from 0.46 to 0.59, indicating a narrow variation and consistent measurement precision across age brackets. The 95% confidence intervals underscored the reliability of these measurements, demonstrating only minor variations that suggest RBC count remains fairly consistent as age increases. The hemoglobin levels across different age groups presented some variability. The mean levels ranged narrowly, from a low of 9.64 g/dL in the 30-39 year group to a high of 10.16 g/dL in the 40-49 year group. Despite these fluctuations, the overlapping confidence intervals indicate that there are no dramatic shifts in hemoglobin levels with aging. However, the statistical analysis revealed significant differences ($\chi^2 = 222.64$, p-value < 0.0001), suggesting that while the mean values are close, the distribution within the groups varies enough to be considered statistically different. This finding underscores the importance of considering age-related changes in hemoglobin levels in clinical assessments and potential implications for health status across the lifespan. Similarly, the white blood cell (WBC) counts across age groups showed consistent averages with a slight increase in older age brackets, peaking at 11.57 × 10^9/L in the 60-69 year group. The standard deviations indicate some variability, especially in the youngest (18-19 years) and oldest (60-69 years) age groups. Although the confidence intervals for these groups overlap, suggesting similar WBC distributions across the age ranges, the chi-square test

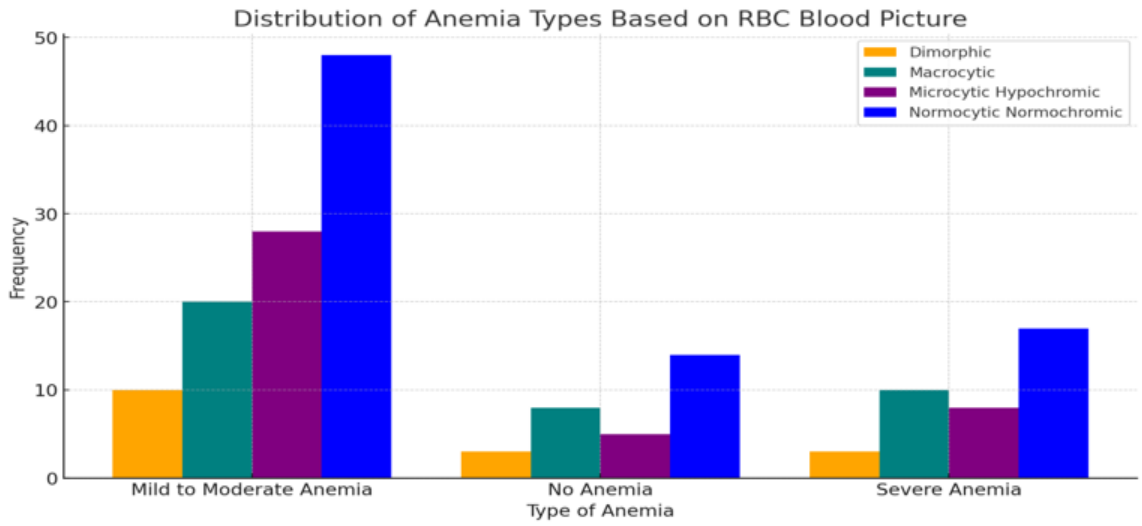
($\chi^2 = 243.61$, p-value < 0.00001) confirmed that the variations are statistically significant. This consistency in WBC counts, with slight increases in older age groups, could reflect changes in immune system activity with age, which might be clinically relevant. We did not find any relevant studies which relates to RBC Count Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics, Hemoglobin Levels Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics and WBC Count Across Age Ranges with 95% Confidence Intervals and Descriptive Statistics.

Our study presents descriptive statistics and confidence intervals for Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC) across various age groups, ranging from 18 to 69 years. For MCV, the mean values remained relatively consistent, ranging from 84.78 fL in the 40-49 age group to 87.6 fL in the 18-19 age group. MCH values also showed minimal variation, with the lowest mean of 27.34 pg in the 18-19 age group and the highest mean of 29.47 pg in the 30-39 age group. Similarly, MCHC percentages were stable across all groups, maintaining an approximate 32% mean value. These narrow 95% confidence intervals and small standard deviations indicate a uniformity in these measurements across different ages. Chi-square tests reveal significant statistical differences in these values across age groups. The chi-square values were notably high (MCV: $\chi^2 = 1848.83$, MCH: $\chi^2 = 655.27$, MCHC: $\chi^2 = 717.63$), with corresponding p-values nearing zero, indicating that these variations, though small, are statistically significant and not due to random chance. This suggests that even minor deviations in red blood cell indices can reflect underlying physiological or environmental influences that vary with age. Additionally, our analysis extends to Platelet Counts and Erythrocyte Sedimentation Rate (ESR) across these age groups, where we observed a pattern of fluctuation. The highest average platelet count was observed in the 60-69 age group (390.39 × 10^9/L), with the lowest in the 30-39 age group (329.97 × 10^9/L). ESR showed peaks in the youngest

and oldest age groups (18-19 and 60-69, with mean values of 62 and 62.78 mm/hr, respectively), suggesting possible increases in inflammatory processes with age. Despite these variations, the chi-square results for platelet count ($\chi^2 = 7270.01$, p-value = 0.0) and ESR ($\chi^2 = 1171.44$, p-value = 4.52×10^{-251}) further confirm that these differences are significant and not merely by chance. We did not find any relevant studies which relates to Descriptive Statistics and 95% Confidence Intervals for MCV, MCH, and MCHC Across Age Ranges, Descriptive Statistics and 95% Confidence Intervals for Platelet Count and ESR Across Age Ranges and Distribution of Therapy Start Time by Gender with Frequencies and Percentages.

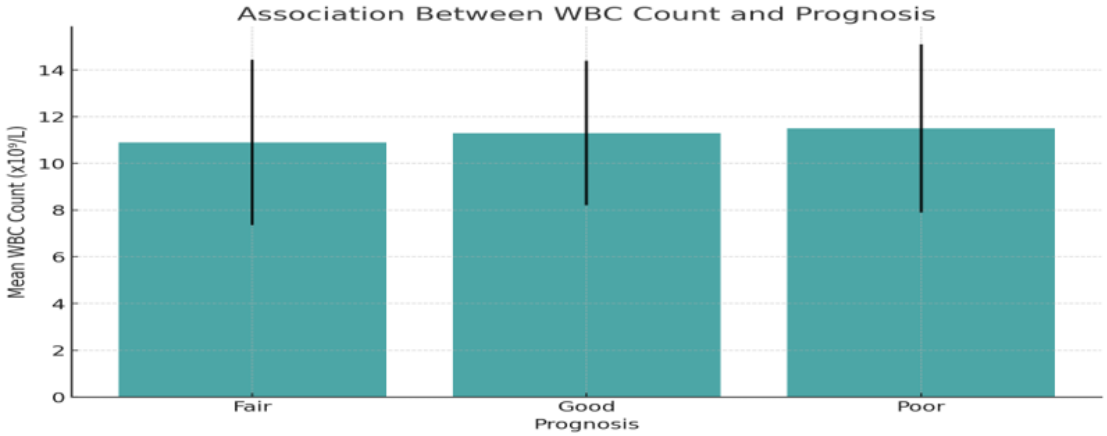
In our study examining the distribution of anemia types based on RBC blood pictures, we analyzed data from 174 patients. The findings are as follows: normocytic normochromic anemia was the most prevalent, with 48 instances (28%) of mild to moderate anemia, 14 cases (8%) of no anemia, and 17 cases (10%) of severe anemia. Microcytic hypochromic anemia was also common, with 28 cases (16%) of mild to moderate anemia, 5 instances (3%) without anemia, and 8 cases (5%) of severe anemia. In the macrocytic category, there were 20 cases (11%) of mild to moderate anemia, 8 (5%) with no anemia, and 10 (6%) of severe anemia. Lastly, the dimorphic group showed the fewest cases, with 10 instances (6%) of mild to moderate anemia, 3 (2%) of no anemia, and 3 (2%) of severe anemia. Statistical analysis using the chi-square test yielded a χ^2 value of 2.28, with a p-value of 0.892, indicating no significant association between the type of RBC blood picture and the prevalence of different anemia types in our patient cohort. This suggests that the distribution of anemia types across different RBC blood pictures in our study is fairly uniform and does not show significant variability. This finding may prompt further investigation into the underlying causes and mechanisms that do not differentiate significantly among the RBC blood picture types in the development of anemia. Govind R et al.,[32] assessed the distribution of various hematological abnormalities in a total of 146 tuberculosis patients. The most common abnormality detected was anemia,

affecting 67.8% (99 patients) of the study population. Anemia was further classified based on severity, with mild anemia observed in 37.4% (37 patients), moderate anemia in 52.5% (52 patients), and severe anemia in 10.1% (10 patients) of the anemic individuals. Regarding the types of anemia based on cell characteristics, normocytic normochromic anemia was the most prevalent, found in 64.6% (64 patients) of those with anemia. This type of anemia is characterized by red blood cells that are normal in size and color but reduced in number. Additionally, microcytic hypochromic anemia, where red blood cells are smaller and paler than usual, was seen in 29.3% (29 patients). Macrocytic anemia, which involves larger than normal red blood cells, was least common, present in 6.1% (6 patients) of anemic patients. These findings highlight the significant impact of tuberculosis on hematological health, with varying degrees of anemia and different red blood cell morphologies reflecting the diverse pathophysiological interactions between tuberculosis and the hematologic system.



In our study, the analysis of prognosis based on therapy start times did not show a significant difference, indicating that the timing of therapy initiation—whether within one, two, or three weeks—does not critically impact patient outcomes. Notably, the highest proportion of "Good" prognoses occurred in patients who started therapy within one or two weeks, at 17% each, and

slightly decreased to 13% when therapy commenced within three weeks. The frequencies of "Fair" and "Poor" prognoses remained relatively consistent across different start times. A chi-square test confirmed these observations with a value of 0.82 and a p-value of 0.936, suggesting no significant association between the timing of therapy initiation and the type of prognosis. This uniform distribution underscores the potential flexibility in therapy start times without compromising outcome efficacy. When examining the relationship between types of anemia and prognosis, a clear and significant pattern emerged. Patients with mild to moderate anemia mostly experienced "Good" prognoses, while those with severe anemia frequently had "Poor" outcomes, indicating a detrimental effect of severe anemia on patient health. This stark contrast is supported by a chi-square value of 77.43 and a highly significant p-value of 6.09×10^{-16}, reinforcing the critical impact of anemia severity on prognosis. These results highlight the necessity for early and effective management of anemia to potentially alter clinical outcomes favorably, particularly to mitigate the risks associated with severe anemia. This distribution not only reflects the direct relationship between anemia severity and patient prognosis but also emphasizes the importance of stratifying patients based on anemia severity for more targeted therapeutic interventions. We did not find any relevant studies which relates to Distribution of Prognosis by Therapy Start Time with Frequencies and Percentages, Distribution of Prognosis by Type of Anemia with Frequencies and Percentages and Distribution of Complications by Type of Anemia with Frequencies and Percentages.



In our study, we examined the association between hemoglobin levels and patient prognosis. We observed that patients with a "Good" prognosis had the highest average hemoglobin levels, at 11.37 g/dL, accompanied by a standard deviation (SD) of 1.84. This compares to a mean of 9.33 g/dL (SD = 1.4) in patients with a "Fair" prognosis and a significantly lower mean of 7.45 g/dL (SD = 1.46) in those with a "Poor" prognosis. These results suggest that higher hemoglobin levels correlate with more favorable clinical outcomes. Statistically, the significance of these differences was confirmed through a chi-square test, which resulted in a chi-square value of 399.35 with a compelling p-value of 1.92×10^{-87}. This indicates a strong statistical association between higher hemoglobin levels and better prognosis, underscoring the potential of hemoglobin as a critical marker for patient outcomes. We assessed the relationship between white blood cell (WBC) counts and prognosis. The findings indicated slight variations in means across different prognostic groups, with the "Poor" prognosis group having the highest average WBC count at 11.5×10^9/L (SD = 3.6). This was slightly higher than the "Good" prognosis group, which had an average of 11.3×10^9/L (SD = 3.1), and the "Fair" prognosis group, at 10.9×10^9/L (SD = 3.54). The chi-square test for this association gave a value of 221.56 and a p-value of 7.75×10^{-49}, reinforcing a statistically significant relationship where higher WBC counts may reflect an adverse prognosis, possibly due to an underlying inflammatory or infectious process. We did not find any relevant studies which relates to

Association Between Hemoglobin Levels (g/dL) and Prognosis and Association between White Blood Cell (WBC) Count (x10^9/L) and Prognosis.

In our study, we explored the association between Red Blood Cell (RBC) count and prognosis in patients. We observed that the mean RBC counts were fairly consistent across the prognosis categories with patients having a "Fair" and "Good" prognosis both showing a mean RBC count of 3.96 million/µL. Interestingly, those categorized with a "Poor" prognosis had a slightly higher mean RBC count of 4.01 million/µL. Despite these subtle differences, the standard deviations remained low across the board, indicating minimal variability within each group. A chi-square test was conducted to assess the statistical significance of these differences, yielding a χ^2 value of 78.16 and a p-value of 1.07×10^{-17}. This highly significant result suggests that there is a meaningful association between RBC count and patient prognosis, highlighting that even small variations in RBC count could be relevant in clinical assessment and prognosis. A closer examination of hematological parameters by gender in our study population revealed some notable differences. Females exhibited a slightly higher mean hemoglobin level of 9.95 g/dL compared to 9.86 g/dL in males, with this difference reaching statistical significance ($\chi^2 = 4.39$, $p = 0.036$). RBC counts were similar between females (3.95 million/µL) and males (3.98 million/µL), with no significant difference ($\chi^2 = 1.22$, $p = 0.269$). In contrast, White Blood Cell (WBC) counts differed more substantially, with females having an average count of 11.42 x10^9/L compared to 10.99 x10^9/L in males, a difference that was statistically significant ($\chi^2 = 8.27$, $p = 0.004$). We did not find any relevant studies which relates to Association between Red Blood Cell (RBC) Count (millions/µL) and Prognosis and Descriptive Statistics of Hematological Parameters by Gender.

Conclusion

CONCLUSION

- The study subjects predominantly fall within the 40-49 and 50-59 age groups, with significant representation also from the 20-29 age group, suggesting higher health awareness or prevalence of the studied condition among these age ranges.
- Gender distribution in the study is balanced, with females comprising 52% and males 48%, indicating no significant bias towards gender in study participation.
- A high proportion (89%) of study subjects tested positive for AFB smear, significantly higher than negative results, which may reflect the selection criteria or prevalence of the condition among the study population.
- The start time for therapy after diagnosis does not show a statistically significant variation, suggesting uniformity in the initiation of treatment among the subjects.
- RBC morphology varied significantly among the study subjects, with Normocytic Normochromic being the most common type, indicating prevalent normal RBC morphology.
- The majority of the study subjects fall into the mild to moderate anemia category, with fewer subjects in the severe anemia or no anemia categories, highlighting a need for interventions focusing on moderate conditions.
- Prognosis distribution shows a majority of subjects categorized as having a "Good" prognosis, but significant numbers also fall into "Fair" and "Poor" categories, underlining the importance of prognostic assessments.
- The occurrence of complications like pneumothorax and lung fibrosis among the subjects indicates a need for targeted management strategies to address these prevalent issues.
- Hemoglobin and WBC levels show significant associations with prognosis, suggesting their potential utility as prognostic indicators in clinical settings.

- RBC count, while stable across different prognostic categories, shows a slight but significant variation that correlates with prognosis, potentially serving as a subtle indicator of patient outcomes.
- Gender differences in hematological parameters are evident, particularly in WBC and hemoglobin levels, pointing to the influence of gender on these measurements and possibly underlying health conditions.

Limitations

LIMITATIONS

1. The study is hospital-based and may not be representative of the general population of pulmonary tuberculosis patients, limiting the generalizability of the findings.
2. The cross-sectional design captures data at a single point in time, which does not allow for the assessment of changes over time or the cause-and-effect relationships between hematological parameters and the prognosis of pulmonary tuberculosis.
3. The study only includes patients aged 18 to 65 years, excluding children, older adults, and pregnant women, which may impact the applicability of the findings to these groups.
4. The exclusion of patients with comorbid conditions such as chronic renal or liver disease, leukemia, or HIV may result in a bias, as these factors could also affect hematological parameters.
5. The study relies on peripheral blood smears, which may have limitations in terms of accuracy and may not fully represent the patient's hematological status compared to more advanced diagnostic techniques.
6. The use of a single method for ESR measurement (Wintrobe method) might limit the broader application of the results, as different methods for ESR estimation could yield varied outcomes.
7. The sample size of 174, while determined based on statistical considerations, may still be insufficient to detect subtle differences in some hematological parameters or to establish definitive prognostic factors.
8. The trial version of SPSS Statistics used for analysis may have some limitations in terms of functionality and may not support all advanced statistical techniques required for more comprehensive analysis.

9. The study did not account for potential confounders such as the severity of tuberculosis, duration of illness, or treatment regimens, which could influence the hematological parameters.
10. The study only focuses on sputum smear-positive or CBNAT-positive patients, excluding those who are negative for these tests but still suffer from tuberculosis, which may lead to a skewed understanding of the general population's hematological status.

Summary

SUMMARY

The study on the prognostic evaluation of hematological parameters in pulmonary tuberculosis patients presents a comprehensive analysis of demographic and clinical data. It highlights that the majority of participants were aged between 40-59 years, reflecting a significant representation of middle-aged individuals.

Gender distribution was relatively balanced, with females slightly outnumbering males.

The study found a high prevalence of positive AFB smear results (89%), indicating a substantial burden of active tuberculosis in the population. Therapy initiation was prompt for most participants, with nearly equal distribution starting within one or two weeks.

Analyzing red blood cell (RBC) blood pictures revealed a predominance of normocytic normochromic morphology, while the most frequent type of anemia was mild to moderate, affecting 61% of the subjects.

The prognosis of patients was generally favorable, with 47% categorized as having a good prognosis.

Complications such as pneumothorax and lung fibrosis were more common among the patients, although a significant portion experienced no complications.

Statistical analyses indicated strong associations between hematological parameters and clinical outcomes. Hemoglobin levels were notably higher in patients with good prognoses, while a correlation between elevated white blood cell (WBC) counts and poorer prognoses was observed. The data suggests that higher RBC counts are slightly associated with poorer outcomes, although the variations were not significant.

Gender differences were present, particularly in hemoglobin and WBC counts, underscoring the need for gender-specific approaches in managing pulmonary tuberculosis.

Overall, the findings emphasize the importance of early detection, timely therapy initiation, and monitoring of hematological parameters to improve patient management and outcomes in pulmonary tuberculosis.

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Master Chart

MASTER CHART

Patient ID	Age	Age Range (10 Years Interval)	Gender	Hemoglobin (g/dL)	RBC Count (millions/µL)	WBC Count (x10^9/L)	MCV (fL)	MCH (pg)	MCHC (%)	Platelet Count (x10^9/L)	ESR (mm/hr)	AFB Smear	Therapy Start Time	RBC Blood Picture	Type of Anemia	Prognosis	Complications
1	56	50-59	Female	6.3	4.02	15.69	83.51	27.62	31.91	175	92	Positive	Within 1 week	Normocytic Normochromic	Severe Anemia	Fair	Hemoptysis
2	46	40-49	Female	12.34	3.41	12.67	81.42	26.5	32.5	158	84	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Good	Pneumothorax
3	32	30-39	Female	8.03	4.22	17.25	85.55	29.41	32.38	420	94	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Poor	None
4	60	60-69	Male	7.81	3.27	15.17	84.08	29.52	33.03	159	86	Positive	Within 2 weeks	Macrocytic	Severe Anemia	Good	Pneumothorax
5	25	20-29	Female	4.24	4.14	4.98	87.57	24.25	32.87	527	71	Positive	Within 2 weeks	Normocytic Normochromic	Severe Anemia	Good	None
6	38	30-39	Female	8.39	3.91	14.2	83.53	29.71	32.77	270	81	Positive	Within 3 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	None
7	56	50-59	Male	9.99	3.13	13.13	92.07	35.51	35.1	274	42	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Good	Hemoptysis
8	36	30-39	Female	9.23	4.53	10.13	85.63	29.41	32.35	319	45	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	Lung Fibrosis
9	40	40-49	Male	9.07	3.92	6.75	83.72	22.9	34.59	221	87	Positive	Within 1 week	Microcytic Hypochromic	Mild to Moderate Anemia	Poor	Hemoptysis
10	28	20-29	Male	7.78	4.93	12.79	90.12	28.53	32.41	301	74	Negative	Within 2 weeks	Normocytic Normochromic	Severe Anemia	Good	None
11	28	20-29	Female	11.73	4.74	4.76	76.89	22.51	31.92	357	25	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Pneumothorax
12	41	40-49	Male	11.92	3.56	10.94	86.7	37.5	31.63	198	54	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
13	53	50-59	Male	10.84	3.6	9.15	85.13	34.71	33.51	303	41	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
14	57	50-59	Male	6.23	3.41	7.22	77.95	26	33.64	496	62	Positive	Within 2 weeks	Macrocytic	Severe Anemia	Good	Pleural Effusion

15	41	40-49	Male	14.55	3.21	14.57	76.46	21.26	32.6	442	34	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Good	None
16	20	20-29	Female	10.29	3.79	10.88	90.05	25.36	33.13	217	79	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Pleural Effusion
17	39	30-39	Male	11.08	4.72	11.52	89.81	27.46	30.72	199	31	Positive	Within 1 week	Microcytic Hypochromic	Mild to Moderate Anemia	Poor	Lung Fibrosis
18	19	18-19	Female	7	3.04	13.72	85.86	22.71	30.45	301	68	Positive	Within 3 weeks	Normocytic Normochromic	Severe Anemia		None
19	41	40-49	Male	9.98	4.43	10.97	93.58	27.79	33.25	168	61	Positive	Within 1 week	Macrocytic	Mild to Moderate Anemia	Good	Pneumothorax
20	61	60-69	Male	10.83	4.38	12.35	87.2	27.44	31.87	249	57	Positive	Within 3 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	Lung Fibrosis
21	47	40-49	Male	9.72	4.28	13.45	91.25	28.38	32.75	209	64	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Poor	None
22	55	50-59	Male	11.74	4.37	12.7	87.1	28.69	31.28	316	54	Positive	Within 3 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	Pleural Effusion
23	19	18-19	Female	12.6	3.45	11.86	83.62	25.1	33.66	351	49	Positive	Within 2 weeks	Normocytic Normochromic	No Anemia	Good	Pneumothorax
24	38	30-39	Female	7.31	4.38	16.35	79.71	25.44	30.46	494	49	Positive	Within 2 weeks	Microcytic Hypochromic	Severe Anemia	Poor	None
25	50	50-59	Male	11.7	3.73	14.73	81.98	28.14	30.61	295	97	Negative	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	Pneumothorax
26	29	20-29	Male	10.79	2.77	10.74	83.71	26.11	33.44	552	25	Positive	Within 1 week	Macrocytic	Mild to Moderate Anemia	Good	Hemoptysis
27	39	30-39	Female	9.99	4.03	8.27	91.82	30.72	29.39	313	86	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
28	61	60-69	Male	6.86	3.58	12.92	88.85	28.11	32.38	588	99	Positive	Within 1 week	Microcytic Hypochromic	Severe Anemia	Poor	Pleural Effusion
29	42	40-49	Male	12.96	4.68	11.65	86.65	33.6	31.89	391	26	Positive	Within 1 week	Microcytic Hypochromic	No Anemia	Good	None
30	44	40-49	Male	10.79	3.86	16.13	89.35	30.46	31.26	218	71	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Good	Lung Fibrosis
31	59	50-59	Female	6.43	4.02	13.96	87.64	31.31	31.8	324	33	Positive	Within 2 weeks	Normocytic Normochromic	Severe Anemia	Poor	Lung Fibrosis
32	45	40-49	Female	9.51	4.19	13.29	86.31	28.4	31.15	198	92	Positive	Within 1 week	Macrocytic	Mild to Moderate Anemia	Fair	None

33	33	30-39	Female	10.65	3.87	11.04	77.51	28.47	33.54	257	34	Positive	Within 2 weeks	Macrocytic	Mild to Moderate Anemia	Good	None
34	32	30-39	Male	11.01	3.95	8.37	90.7	33.19	33.8	375	40	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	Lung Fibrosis
35	64	60-69	Male	9.74	4.42	10.41	82.71	26.87	31.31	310	54	Positive	Within 2 weeks	Macrocytic	Mild to Moderate Anemia	Fair	None
36	61	60-69	Female	10.68	3.47	12.43	90.44	29.64	32.28	268	85	Positive	Within 3 weeks	Dimorphic	Mild to Moderate Anemia	Good	Lung Fibrosis
37	20	20-29	Female	14.24	3.65	5.81	90.93	27.2	30.67	298	21	Negative	Within 3 weeks	Macrocytic	No Anemia	Good	None
38	54	50-59	Female	13.09	3.52	14.73	81.65	27.19	33.07	299	54	Positive	Within 2 weeks	Normocytic Normochromic	No Anemia	Good	Pleural Effusion
39	24	20-29	Female	8.1	4.72	17.2	89.75	24.49	33.05	581	97	Positive	Within 3 weeks	Macrocytic	Mild to Moderate Anemia	Poor	Lung Fibrosis
40	38	30-39	Male	8.81	3.65	5.17	83.2	25.77	31.7	442	39	Negative	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Poor	Hemoptysis
41	26	20-29	Female	9.78	3.93	6.8	83.22	25.22	32.02	292	29	Positive	Within 1 week	Dimorphic	Mild to Moderate Anemia	Fair	None
42	56	50-59	Male	6.5	3.7	11.69	86.29	29.78	31.91	568	44	Positive	Within 2 weeks	Microcytic Hypochromic	Severe Anemia	Poor	Pneumothorax
43	35	30-39	Female	7.32	3.85	9.25	86.42	31.12	30.38	309	85	Positive	Within 1 week	Normocytic Normochromic	Severe Anemia	Fair	Pneumothorax
44	21	20-29	Male	6.76	3.63	11.78	85.19	27.72	33.55	160	44	Positive	Within 2 weeks	Macrocytic	Severe Anemia	Poor	None
45	42	40-49	Female	7.7	4.23	10.78	78.33	28.69	31.23	287	73	Positive	Within 2 weeks	Normocytic Normochromic	Severe Anemia	Fair	None
46	31	30-39	Female	12.78	3.48	7.93	84.39	27.54	31.24	227	52	Positive	Within 1 week	Dimorphic	No Anemia	Good	None
47	26	20-29	Female	8.29	3.32	14.87	96.39	25.57	31.85	226	55	Positive	Within 3 weeks	Dimorphic	Mild to Moderate Anemia	Fair	Lung Fibrosis
48	43	40-49	Female	7.95	3.72	12.39	71.08	30.59	33	590	33	Negative	Within 1 week	Microcytic Hypochromic	Severe Anemia	Fair	Pneumothorax
49	19	18-19	Male	11.77	3.6	9.32	89.35	29.96	31.41	403	84	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
50	37	30-39	Female	9.1	3.33	15.52	90.29	22.32	30.05	558	99	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Fair	Lung Fibrosis

51	45	40-49	Male	10.84	3.84	9.47	78.21	27.15	31.11	407	73	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
52	64	60-69	Male	8.54	3.17	7.27	82.65	25.35	32.42	469	71	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
53	24	20-29	Male	6.4	4.86	11.55	80	26.83	34.19	440	22	Positive	Within 2 weeks	Macrocytic	Severe Anemia	Poor	Hemoptysis
54	61	60-69	Male	10.94	3.25	12.06	94.27	25.99	30.74	412	60	Negative	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	Hemoptysis
55	25	20-29	Female	6.9	3.68	12.6	90.52	27.86	30.7	234	25	Positive	Within 3 weeks	Normocytic Normochromic	Severe Anemia	Poor	Pneumothorax
56	64	60-69	Male	8.98	3.8	13.09	90.76	27.01	30.49	295	44	Positive	Within 3 weeks	Dimorphic	Mild to Moderate Anemia	Good	None
57	52	50-59	Male	8.53	4.84	12.55	85.6	26.95	30.36	472	32	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Lung Fibrosis
58	31	30-39	Male	10.39	3.13	12.43	91.56	31.32	33.21	191	27	Negative	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
59	34	30-39	Female	8.89	4.07	9.28	84.96	29.67	33.49	523	40	Positive	Within 2 weeks	Dimorphic	Mild to Moderate Anemia	Fair	None
60	53	50-59	Female	9.74	4.52	8.96	91.8	25.89	32.18	274	87	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
61	57	50-59	Female	6.88	3.85	13.23	84.26	26.33	31.53	316	44	Positive	Within 2 weeks	Macrocytic	Severe Anemia	Poor	Pneumothorax
62	21	20-29	Female	14	3.42	11.73	81.6	29.48	33.79	574	98	Negative	Within 1 week	Dimorphic	No Anemia	Good	Pneumothorax
63	19	18-19	Male	7.6	3.95	13.46	94.05	29.47	32.17	390	87	Positive	Within 1 week	Dimorphic	Severe Anemia	Fair	None
64	23	20-29	Male	12.4	4.76	5.88	84.9	26.19	33.09	429	64	Negative	Within 2 weeks	Microcytic Hypochromic	No Anemia	Good	Pneumothorax
65	59	50-59	Female	10.3	3.69	9.5	80.51	27.3	31.48	337	79	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Hemoptysis
66	21	20-29	Male	10.28	4.72	16.72	80.45	33.54	32.04	451	31	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
67	46	40-49	Male	10.71	4.13	12.66	80.47	26.24	30.76	168	51	Positive	Within 3 weeks	Macrocytic	Mild to Moderate Anemia	Fair	Lung Fibrosis
68	35	30-39	Male	6.24	4.62	11.89	89.22	33.73	32.63	217	32	Positive	Within 2 weeks	Macrocytic	Severe Anemia	Poor	Pleural Effusion

69	43	40-49	Female	11.93	4.11	13.12	84.51	31.31	32.19	367	50	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	None
70	61	60-69	Female	8.98	3.76	17.63	96.49	33.18	31.11	251	97	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
71	51	50-59	Male	12.42	4.82	16.99	90.93	26.11	31.12	191	39	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Fair	Pneumothorax
72	27	20-29	Female	9.7	4.11	6.26	86.29	27.49	33.62	437	37	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Poor	Pneumothorax
73	53	50-59	Female	9.25	4.08	7.37	92.02	26.65	33.97	316	79	Positive	Within 2 weeks	Macrocytic	Mild to Moderate Anemia	Good	Pleural Effusion
74	31	30-39	Female	7.42	4.4	6.16	82.52	31.38	31.79	258	82	Negative	Within 1 week	Microcytic Hypochromic	Severe Anemia	Fair	None
75	48	40-49	Female	8.47	4.46	8.76	75.73	26.3	32.07	185	25	Negative	Within 3 weeks	Dimorphic	Mild to Moderate Anemia	Fair	Hemoptysis
76	65	60-69	Female	10.84	4.41	11.16	80.05	30.19	32.4	381	51	Positive	Within 3 weeks	Macrocytic	Mild to Moderate Anemia	Good	None
77	32	30-39	Male	7.38	3.32	11.73	85.74	30.03	32.15	378	62	Positive	Within 2 weeks	Normocytic Normochromic	Severe Anemia	Poor	None
78	25	20-29	Female	6.02	3.68	6.41	83.89	27.86	30.33	502	21	Positive	Within 3 weeks	Microcytic Hypochromic	Severe Anemia	Poor	Pneumothorax
79	31	30-39	Male	8.28	3.67	5.4	89.12	31.9	32.43	313	79	Positive	Within 3 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Fair	None
80	40	40-49	Male	11.68	3.61	8.71	84.38	28.32	29.91	536	42	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	None
81	57	50-59	Female	13.56	3.56	13.75	88.74	30.5	31.27	222	50	Positive	Within 3 weeks	Macrocytic	No Anemia	Good	None
82	38	30-39	Male	8.65	3.66	14.27	92.5	26.52	32.51	285	24	Positive	Within 3 weeks	Macrocytic	Mild to Moderate Anemia	Fair	None
83	33	30-39	Male	6.9	4.17	16.12	84.36	25.83	32.6	502	53	Positive	Within 3 weeks	Macrocytic	Severe Anemia	Poor	None
84	62	60-69	Male	9.31	4.25	10.9	87.78	30.19	31.19	528	29	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Hemoptysis
85	35	30-39	Female	10.37	4	13.48	76.23	29.29	31.54	219	21	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
86	64	60-69	Female	11.16	3.79	14.03	84.38	28.73	31.41	574	30	Positive	Within 2 weeks	Macrocytic	Mild to Moderate Anemia	Good	Lung Fibrosis

87	41	40-49	Male	14.27	4.64	9.51	78.84	26.97	31.9	345	69	Positive	Within 2 weeks	Normocytic Normochromic	No Anemia	Good	Lung Fibrosis
88	43	40-49	Female	10.45	3.95	12.16	85.73	32.65	31.97	418	50	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Hemoptysis
89	42	40-49	Female	13.31	4.47	12.98	86.18	24.65	32.67	198	75	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Good	None
90	62	60-69	Female	9.07	3.72	8.27	86.16	24.49	31.48	465	98	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Fair	Pleural Effusion
91	58	50-59	Female	10.17	4.21	15.93	82.6	30.83	32.37	279	92	Negative	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Pneumothorax
92	46	40-49	Male	8.81	4.67	10.88	96.49	30.58	32.51	593	28	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Poor	Pneumothorax
93	32	30-39	Male	8.64	2.7	11.26	78.66	29.06	32.2	154	40	Positive	Within 1 week	Dimorphic	Mild to Moderate Anemia	Fair	Pneumothorax
94	62	60-69	Female	9.47	3.67	8.16	78.35	27.14	31.74	577	92	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Pleural Effusion
95	18	18-19	Female	9.44	4.3	8.66	93.27	29.51	32.18	176	47	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
96	42	40-49	Male	8.79	4.61	4.41	81.48	33.16	32.75	309	81	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Lung Fibrosis
97	24	20-29	Male	8.9	4.1	11.17	80.28	35.55	32.84	298	26	Positive	Within 1 week	Macrocytic	Mild to Moderate Anemia	Fair	Pneumothorax
98	26	20-29	Female	12.19	4.02	18.52	96.51	23.03	33.82	413	99	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Good	Lung Fibrosis
99	41	40-49	Male	14.23	4.81	7.94	89.93	26.74	31.01	379	35	Negative	Within 3 weeks	Normocytic Normochromic	No Anemia	Good	Hemoptysis
100	18	18-19	Female	9	4.64	19.93	82.03	26.55	31.56	349	23	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
101	61	60-69	Female	9.35	3.57	15.24	86.09	32.88	30.39	199	23	Positive	Within 1 week	Macrocytic	Mild to Moderate Anemia	Fair	Hemoptysis
102	25	20-29	Male	11.05	4.06	9.58	94.73	20.56	32.93	216	59	Positive	Within 1 week	Microcytic Hypochromic	Mild to Moderate Anemia	Good	None
103	41	40-49	Male	16.37	4.18	11.08	88.46	29.54	31.67	449	36	Positive	Within 1 week	Macrocytic	No Anemia	Good	None
104	28	20-29	Female	10.17	4.86	10.59	91.43	27.23	32.21	530	71	Positive	Within 1 week	Dimorphic	Mild to Moderate Anemia	Fair	None

105	34	30-39	Female	11.95	4.43	16.12	89.02	32.91	31.4	207	71	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
106	25	20-29	Male	13.09	3.95	12.55	89.65	32.5	31.67	408	55	Positive	Within 1 week	Macrocytic	No Anemia	Good	Pneumothorax
107	52	50-59	Female	10.69	4.11	14.55	85.2	29.1	33.22	491	57	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
108	52	50-59	Male	11.85	3.06	12.07	85.06	23.26	32.69	475	69	Positive	Within 1 week	Macrocytic	Mild to Moderate Anemia	Good	None
109	50	50-59	Female	11.22	4.48	10.66	86.34	26.28	31.89	279	82	Positive	Within 3 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	Hemoptysis
110	22	20-29	Male	12.07	4.32	11.98	88.67	26.61	32.77	364	82	Positive	Within 2 weeks	Macrocytic	No Anemia	Fair	Pleural Effusion
111	59	50-59	Male	7.93	4.61	9.78	83.58	24.02	32.79	321	81	Positive	Within 1 week	Normocytic Normochromic	Severe Anemia	Poor	Pleural Effusion
112	56	50-59	Male	10.41	3.93	6.64	85.61	31.46	31.61	407	26	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	Pleural Effusion
113	58	50-59	Female	10.96	4.06	13.44	83.45	23.64	30.53	251	46	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	Lung Fibrosis
114	45	40-49	Female	10.93	3.76	6.5	85.58	33.9	31.1	358	33	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
115	24	20-29	Male	12.27	3.43	10.19	78.75	33.89	30.66	440	90	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Good	None
116	26	20-29	Female	10.89	3.7	9.68	98.03	26.84	33.16	503	24	Negative	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Good	Lung Fibrosis
117	25	20-29	Male	7.71	3.09	12.93	81.34	28.99	33.34	435	74	Positive	Within 1 week	Normocytic Normochromic	Severe Anemia	Poor	None
118	29	20-29	Male	11.18	4.46	15.69	83.19	27.78	33.59	265	21	Positive	Within 1 week	Microcytic Hypochromic	Mild to Moderate Anemia	Good	Lung Fibrosis
119	51	50-59	Female	8.23	2.91	14.61	80.9	30.71	29.98	413	81	Positive	Within 2 weeks	Macrocytic	Mild to Moderate Anemia	Fair	None
120	50	50-59	Female	8.6	5.02	13.02	88.08	31.82	33.07	299	40	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Fair	None
121	65	60-69	Male	9.16	3.12	9.11	84.02	28.77	34.21	449	98	Negative	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Pneumothorax
122	40	40-49	Female	9.78	4.75	10.45	80.18	29.41	33.11	591	40	Negative	Within 1 week	Microcytic Hypochromic	Mild to Moderate Anemia	Fair	Pneumothorax

123	41	40-49	Female	6.91	3.55	10.01	88.28	26.14	29.85	185	29	Positive	Within 3 weeks	Normocytic Normochromic	Severe Anemia	Poor	Pneumothorax
124	54	50-59	Male	12.23	4.28	9.59	88.96	29.31	33.77	482	77	Positive	Within 2 weeks	Dimorphic	No Anemia	Good	Lung Fibrosis
125	52	50-59	Male	7.69	3.62	9.79	84.67	28.49	32.04	436	58	Positive	Within 1 week	Normocytic Normochromic	Severe Anemia	Fair	None
126	61	60-69	Female	13.14	4.84	9.71	81.68	25.26	31.77	452	24	Negative	Within 1 week	Macrocytic	No Anemia	Good	None
127	57	50-59	Male	7.75	4.02	9.58	95.96	27.96	32.45	460	84	Positive	Within 2 weeks	Dimorphic	Severe Anemia	Poor	Pleural Effusion
128	39	30-39	Male	12.56	4.54	13.86	86.7	26.85	30.95	357	32	Positive	Within 2 weeks	Macrocytic	No Anemia	Good	Lung Fibrosis
129	44	40-49	Female	9.94	4.04	7.84	78.63	26.17	32	255	72	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Fair	None
130	52	50-59	Male	6.57	4.18	8.81	92.07	24.56	33.62	595	64	Positive	Within 2 weeks	Macrocytic	Severe Anemia	Poor	Pleural Effusion
131	18	18-19	Male	7.91	4.31	6.25	80.72	28.19	32.62	307	51	Positive	Within 2 weeks	Dimorphic	Severe Anemia	Fair	None
132	52	50-59	Female	12.65	3.74	15.25	98.71	25.66	32.06	270	55	Positive	Within 1 week	Microcytic Hypochromic	No Anemia	Good	None
133	54	50-59	Female	10.9	3.36	8.61	85.4	26.59	32.09	204	79	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	None
134	64	60-69	Male	9.84	3.35	12.98	90.07	31.23	30.82	549	30	Positive	Within 1 week	Microcytic Hypochromic	Mild to Moderate Anemia	Fair	Lung Fibrosis
135	31	30-39	Male	5.57	4.03	12.43	74.6	29.9	31.85	161	82	Positive	Within 1 week	Microcytic Hypochromic	Severe Anemia	Poor	Lung Fibrosis
136	20	20-29	Female	12.78	3.76	14.96	78.58	25.06	30.37	294	40	Positive	Within 2 weeks	Microcytic Hypochromic	No Anemia	Good	None
137	18	18-19	Female	13.74	2.93	10.37	91.67	29.06	33.02	549	71	Positive	Within 2 weeks	Microcytic Hypochromic	No Anemia	Fair	Pleural Effusion
138	22	20-29	Female	13.38	4.26	8.16	86.59	28.4	29.81	545	74	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Good	None
139	43	40-49	Female	8.77	3.39	6.33	95.21	33.11	32.85	285	45	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
140	31	30-39	Male	10.77	3.42	2.65	87.43	32.15	32.98	152	87	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None

141	56	50-59	Female	10.98	3.98	11.48	85.73	23.4	33.32	293	53	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
142	44	40-49	Female	6.95	3.55	13.33	93.57	30.58	32.09	179	71	Positive	Within 3 weeks	Normocytic Normochromic	Severe Anemia	Poor	None
143	26	20-29	Male	10.36	4.06	12.42	90.05	31.8	32.92	386	71	Positive	Within 1 week	Microcytic Hypochromic	Mild to Moderate Anemia	Good	Pneumothorax
144	32	30-39	Female	12.14	4.99	6.41	84.02	29.68	31.84	428	48	Positive	Within 3 weeks	Normocytic Normochromic	No Anemia	Good	Pleural Effusion
145	32	30-39	Male	11.53	3.81	14.12	79.53	26.99	30.81	497	57	Positive	Within 2 weeks	Macrocytic	Mild to Moderate Anemia	Good	Pneumothorax
146	43	40-49	Female	7.78	3.47	8.91	73.14	35.24	33.53	264	61	Positive	Within 3 weeks	Normocytic Normochromic	Severe Anemia	Fair	None
147	59	50-59	Female	8.27	4.09	8.28	82.81	29.95	31.9	253	40	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
148	30	30-39	Female	11.58	3.61	8.84	79.07	33.93	30.59	267	61	Positive	Within 3 weeks	Macrocytic	Mild to Moderate Anemia	Good	None
149	49	40-49	Male	11.27	4.01	11.24	97.99	32.05	31.53	154	32	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	None
150	56	50-59	Male	5.49	4.16	6.55	81.75	29.39	31.57	509	83	Positive	Within 3 weeks	Normocytic Normochromic	Severe Anemia	Poor	Lung Fibrosis
151	49	40-49	Female	5.09	3.98	10.89	81.61	26.26	32.46	397	36	Positive	Within 3 weeks	Macrocytic	Severe Anemia	Poor	None
152	21	20-29	Male	9.85	4.03	12.29	77.39	27.93	34.35	513	28	Positive	Within 3 weeks	Macrocytic	Mild to Moderate Anemia	Fair	Lung Fibrosis
153	47	40-49	Male	8.82	4.1	14.32	83.67	27.33	32.52	470	60	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Fair	Pleural Effusion
154	54	50-59	Male	9.4	4.8	11.53	81.68	24.36	32.21	270	20	Positive	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	None
155	40	40-49	Male	9.18	3.87	6.98	93.69	29.95	34.46	435	21	Positive	Within 1 week	Dimorphic	Mild to Moderate Anemia	Fair	Pleural Effusion
156	56	50-59	Male	11.97	4.06	11.45	85.84	32.7	32.98	298	79	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Fair	Pneumothorax
157	62	60-69	Male	10.21	4.43	7.82	84.96	27.11	32.25	233	67	Positive	Within 3 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	Pneumothorax
158	32	30-39	Female	10.54	4.24	7.65	84.33	34.49	31.52	555	48	Positive	Within 2 weeks	Macrocytic	Mild to Moderate Anemia	Fair	Pneumothorax

159	60	60-69	Female	7.32	3.82	6.91	88.93	23.33	32.32	380	29	Positive	Within 2 weeks	Normocytic Normochromic	Severe Anemia	Poor	None
160	46	40-49	Male	5.33	4.45	5.27	82.74	31.16	31.93	437	77	Positive	Within 3 weeks	Microcytic Hypochromic	Severe Anemia	Poor	None
161	53	50-59	Female	12.25	3.56	9.3	88.34	33.01	32.09	310	79	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Good	None
162	30	30-39	Female	14.29	3.89	14.39	93.07	27.39	33.31	421	40	Positive	Within 3 weeks	Macrocytic	No Anemia	Good	None
163	49	40-49	Female	9.31	3.61	17.77	87.3	27.44	31.46	187	47	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Poor	Pneumothorax
164	24	20-29	Female	10.5	4.29	9.28	83.75	31.13	32.51	375	94	Negative	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	None
165	39	30-39	Male	10.65	4.59	14.26	80.23	29.52	32.95	291	53	Negative	Within 3 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Good	Hemoptysis
166	45	40-49	Female	13.35	4.11	9.82	83.62	22.01	31.34	441	27	Positive	Within 1 week	Normocytic Normochromic	No Anemia	Good	Lung Fibrosis
167	19	18-19	Female	11.78	4.04	6.05	87.82	25.47	31.18	300	78	Positive	Within 1 week	Microcytic Hypochromic	Mild to Moderate Anemia	Good	None
168	59	50-59	Male	10.99	3.56	13.1	77.34	27.96	31.85	263	91	Positive	Within 2 weeks	Macrocytic	Mild to Moderate Anemia	Good	None
169	62	60-69	Male	10.11	3.65	11.7	89.16	23.89	31.54	386	68	Positive	Within 2 weeks	Microcytic Hypochromic	Mild to Moderate Anemia	Good	Pleural Effusion
170	23	20-29	Female	10.12	3.4	16.45	86.04	26.58	33.15	215	98	Positive	Within 1 week	Normocytic Normochromic	Mild to Moderate Anemia	Poor	Pleural Effusion
171	45	40-49	Female	7.12	2.91	6.4	84.25	23.97	31	510	36	Positive	Within 3 weeks	Macrocytic	Severe Anemia	Fair	Lung Fibrosis
172	45	40-49	Female	9.23	3.8	19.39	81.7	26.89	32.07	490	79	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None
173	61	60-69	Female	11.77	3.85	15.78	82.62	26.99	34.55	407	64	Positive	Within 1 week	Dimorphic	Mild to Moderate Anemia	Good	None
174	61	60-69	Female	9.53	5.09	10.95	87.99	29.06	32.41	398	88	Positive	Within 2 weeks	Normocytic Normochromic	Mild to Moderate Anemia	Fair	None

Annexures

ANNEXURES

PROFORMA

HISTORY

Reg No.

AGE DATE

DOB

SEX

ADDRESS

CONTACT NO

Presenting complaints, other significant history and Duration

COMPLAINTS	**DURATION**
Fever	+/-
Cough	+/-
Weight loss	+/-
Night sweats	+/-
Fatigue	+/-
Loss of Appetite	+/-
Malaise	+/-
Weakness	+/-
Breathlessness	+/-

EXAMINATION

Conscious	+/-
Oriented	+/-
Temperature F	+/-
Pulse/min	+/-
Blood Pressure mm of Hg	+/-

Respiratory Rate/min	+/-
Pallor	+/-
Icterus	+/-
Cyanosis	+/-
JVP	+/-
Clubbing	+/-
Pedal edema	+/-
Lymphadenopathy	+/-
Nails	+/-
Chest	+/-
CVS	+/-
PA	+/-
CNS	+/-

BIOCHEMICAL PROFILE:

HB

RBC COUNT

PLATELET COUNT

MCV

MCH

MCHC

WBC

ESR

PERIPHERAL BLOOD SMEAR

CONSENT FORM (ENGLISH)

I_____ age_____ sex_____ give my full free and valid consent to be subject in the study titled "**Prognostic evaluation of hematological parameters in pulmonary tuberculosis patients**."

I have been informed to my full satisfaction about the purpose, nature and various laboratory investigations for the study to be carried out. I have been informed about the duration of study and instructions to be followed during study period. I realize that this is being done for the sake of knowing the changes in the Hematological parameters in pulmonary tuberculosis. This can prevent us from taking any wrong therapeutic decision regarding tuberculosis patients.

I am aware of my right to opt out of study at any time during the course of study.

Date: Patient/patient's relative's

Place: Signature or thumb impression

Name:

Signature of treating physician

Date:

Place:

Name: Signature of witness

सहमति पत्र

दिनांक –

मैं ..... उम्र ..... निवासी .... घोषणा करता/करती हूँ कि मैं थीसिस अध्ययन में भाग लेने के लिए अपनी सहमति देता/देती हूँ , जिसका शीर्षक है '' फेफड़े का क्षयरोग में रक्त संबंधी मापदंडों का पूर्वानुमानात्मक मूल्यांकन '' मैंनें रोगी सूचना पत्र और इसके बारे में सारे प्रश्नों को अच्छी तरह पढ़ लिया है। इस अध्ययन का डाटा इस शर्त पर है कि मेरे सभी विवरण गोपनीय रखे जाने हैं।

मैं संतोष अस्पताल, गाजियाबाद उ0प्र0 में अपने आगे के इलाज का का अधिकारी तथ्ज्ञा जब भी मैं जाना चाहता/चाहती हूँ या अध्ययन से अपने हटने के अधिकार को सुरक्षित रखता हूँ।

मरीज के हस्ताक्षर नाम

रिश्तेदार के हस्ताक्षर नाम

गवाह के हस्ताक्षर नाम

डाक्टर के हस्ताक्षर नाम

तिथि –

ETHICAL CLEARANCE

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

F. No. SU/R/2023/2489[93] Dated: 26.09.2023

Subject: Grant of Ethical Clearance for **Thesis Protocol** Topic **"Prognostic evaluation of hematological parametrs in pulmonary tuberculosis patients",** submitted by **Dr. AJAY NAGAR,** MD/MS student of Batch 2022-2023, Department of **PATHOLOGY**.

*****

With reference to his/her request for grant of Ethical Clearance for the Thesis Protocol entitled **"Prognostic evaluation of hematological parametrs in pulmonary tuberculosis patients"**, **Dr. AJAY NAGAR** is informed that the **Thesis Protocol** submitted by him/her was considered by the **Screening Committee** of the Santosh Medical College & Hospital in its meetings held on 17.07.2023 to 28.07.2023. The recommendations of the **Screening Committee** were considered in detail by the **Institutional Ethics Committee** in its meeting held on **23.09.2023** and the same was **approved** by the **Ethics Committee**.

He /She is informed accordingly for further necessary action.

[Dr. NARESH SHARMA]
REGISTRAR

SANTOSH "DEEMED TO BE UNIVERSITY" GHAZIABAD, (U.P.) REGISTRAR

Dr. AJAY NAGAR
MD/MS student of batch 2022-2023
Department of PATHOLOGY
Email: ajaynagarindia84@gmail.com

Copy to:

1. The Vice Chancellor
2. The Dean, SMC&H
3. The Dean – Academics
4. The Dean – Research
5. The Director - IQAC
6. Dr. Reena Agarwal (Guide)
7. HOD of PATHOLOGY

DISSERTATION WORKSHOP CERTIFICATE

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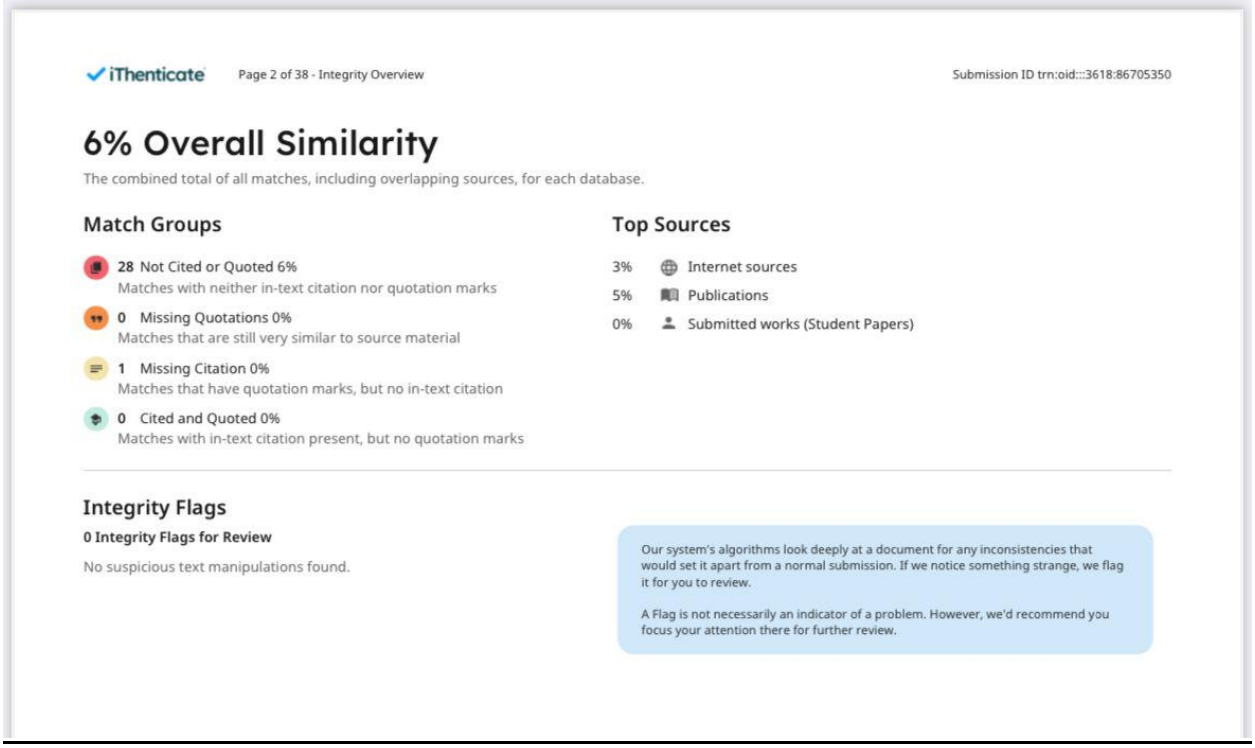

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